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Burlington, Massachusetts

AVIATION CALENDAR

(Continued from page 4)

national Air Transport Assn., Miami

Sept. 11-12-1966 Annual Instrument

Aviation Conference & Exhibit, Cleve-

land, Ohio

Sept. 13-Third Pacific Area National Meet-

ing, American Society for Testing and

Materials, Sheraton-Palace Hotel, San Fran-

cisco, Calif.

Sept. 15-1957 Gaudin Prize and Fling

Drifts, Royal Aeronautical Society, War-

terbury, Wiltshire, England

Sept. 16-17-1966 Airframe Symposium

Conference, jointly sponsored by Union

of Michigan Transportation Institute,

Western Michigan University, and the

Aero Club of Michigan, Ann Arbor

Sept. 20-21-North Central Regional Con-

ference, Civil Air Patrol, Torrey House

Hotel, Kansas City, Mo.

Sept. 30-Oct. 3-National Aeronautics Meet-

ing, Aircraft Production Forum & Air-

craft Engineering Display, Society of

Aeronautical Engineers, Hotel Ambrosia,

Los Angeles

Oct. 2-4-Trade Annual Meeting and

Forum, National Business Aerosol Assn.,

Conrad Hotel, Denver, Colo.

Oct. 30-1966 Annual National Electronics

Conference, Chicago, Ill.

Oct. 7-8-Third Annual Inspection, Low

Field Propulsion Laboratory, Cleveland

Oct. 7-10-1966 Annual Congress, Inter-

national Advanced Polymers, Encen-

son, Spain. For details write: IAP, 31

Laurel Rd., Concord, Mass.

Oct. 9-10-National Fall Convention, So-

ciety for Experimental Stress Analysis, El

Corte Hotel, San Diego, Calif.

Oct. 10-11-National Noise Abatement Sym-

posium, Sheraton Hotel, Chicago, Ill.

Oct. 11-12-Canadian Aeronautical Insti-

tute Institute of the Aeronautical Sciences

Meeting, Montreal, Canada

Oct. 21-23-Conference on new develop-

ments in the field of power, American

Society of Mechanical Engineers, Ameri-

can Hotel, Allentown, Pa.

Oct. 24-25-Quarterly Annual Display, Air-

craft Historical Engineering, Aircraft En-

gineering Society, Fox Pacific Auditorium,

Los Angeles, Calif.

Oct. 25-1966 Winter Meeting, Ameri-

can Nuclear Society, Hotel Hudson

Hotel, N. Y.

Oct. 25-26-Third Annual Meeting, As-

sociation of the U. S. Army, Sheraton Park

Hotel, Washington, D. C.

Oct. 28-30-Annual East Coast Conference

on Aeronautical and Nonaeronautical El-

ectronics, Ritz Regency Assoc., Bal-

timore, Md.

Oct. 29-31-National Industrial Packaging

& Handling Exposition, Atlantic City,

Coronado Hotel, N. J.

Oct. 30-Nov. 1-Electrical Engineering

Display, U. S. Coast Hotel, San Diego,

Calif.

Nov. 1-3-1966 Military Industry Control

Vehicle Reliability Symposium, Sheraton

Hotel, Las Vegas, Nev.

Nov. 4-6-1966 Annual Meeting, Aero-

space Society, Sheraton Hotel, Las Vegas,

Nev.

Nov. 10-12-1966 International Air Transport

Assn. Technical Conference, Miami, Fla.

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 301 E. Alameda, New York 17, N.Y.

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to users of integrating gyros

AND IF YOUR SYSTEM REQUIRES AN INTEGRATING GYROSCOPE...

It is important that the Gyro be *truly* integrating.

The following are a few basic checks that can be simply made to determine whether the Gyro is a true Integrating Gyroscope.

1. With Gyro at null, rotate Gyro about its input axis in a positive (clockwise) direction approximately 50 milliradians.
2. Observe the output voltage and polarity. A true Integrating Gyro should show a positive output of a magnitude determined by the product of the angular displacement in milliradians and its rated sensitivity (millivolts/milliradians).
3. The output should remain at this reading providing there is no further input (either angular or command). At this point no drift is being taken into consideration. However, all gyros will drift to a greater or smaller degree. Observe this drift as to direction and magnitude with respect to time.
4. Repeat the above with a negative (counter clockwise) input of approximately 50 milliradians.
5. Observe the output voltage and polarity. A true Integrating Gyro will show a negative output equal to the product of angular displacement in milliradians and its rated sensitivity (millivolts/milliradians) and hold this output.
6. If the Gyro tends to return to null in both of the above conditions, it is not a true Integrating Gyro.

If you have made the foregoing checks and wish any further information, please call or Greenleaf. It is our sincere desire to provide the utmost in service to Integrating Gyroscope users.



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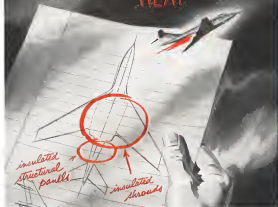
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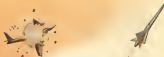


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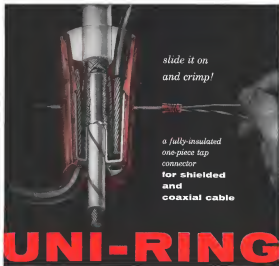
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Aeroplanes Based on Supersonic Efficiency 26

► Sacrifice of some subsonic performance was made to fit engine for extended operation above Mach 1

Gen. Baker Assumes Capital Presidency 39

► Committee will chart policy as board chairman; financial expert Baker plans tighter economy

Space, Weight Gain Boon Liquid Oxygen 66

► Military use is well advanced, but civilians are concerned with handling problems

MISSILE ENGINEERING

► Rocket, Boosted as Targets

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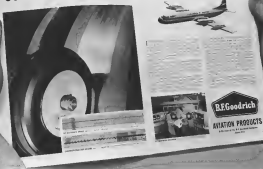
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 Heat and subtle manipulation

As most industries slide into the sunset, doleful is the aviation industry's lotting with a wide variety of management problems. We warned at this year's began (AWJ, Jan. 7, p. 21) that 1957 would be a year in which the aviation industry, both in its manufacturing and transport segments, would have to solve some knotty problems to insure continued prosperity. As we put the mid-year mark, it is clearly evident that the problems we outlined have grown more acute and have been joined by another group precipitated primarily by government policies. These government policies are both short-sighted and dangerous because, unless modified, they will undermine the foundations of our national defense and our cultural air transport system.

received. It is also ironic that when any proposal appears—such as the recommendations of the committee headed by Ralph Cordiner, chief executive of the General Electric Co., on an equitable pay scale for military technicians—it is quickly jettisoned as "irrelevant." Implementing the Cordiner committee's report would soon shore up two to three billion dollars from the defense budget—a welcome relief for all taxpayers.

In the airline business the financial squeeze is also coming from government policy. The Civil Aeronautics Board staff has its own methods of bookkeeping to prove airline profits are much higher than they are and chooses to ignore the rising cost curve that is eating profit out of airlines. It is also standing upbraiding by what United States domestic traffic rights are being traded now to foreign airlines.

Progress on providing adequate traffic control and ground facilities for the jet age is still painfully slow. A prime example is the armless customs, over providing an airport adequate for jet transport to serve Washington, D. C., the nation's capital. Maryland and Virginia airports will still be wheezing debate on this subject when jet transports used by Washington on their way to serve cities that have provided adequate facilities.

Perhaps the most serious problem is the fiscal maddening now going on in the Pentagon. Various executives who have battled through the feast and famine cycles of the aircraft industry for the past 30 years tell us that never in history has the fiscal reengineering of the defense business been in such a chaotic condition.

Congress has been thoroughly confused by the almost weekly, signal-to-noise-it comes from the Pentagon and the White House on the Fiscal 1978 defense budget. The military services which prepare complex, hard-to-read aerial weapon systems have been thoroughly confused by the fiscal directives and subsequent signals that have descended on them from the Secretary of Defense's office. And the contractors trying to do business with the Pentagon under a constantly shifting set of fiscal policies are in a genuine fixated bind.

Aviation in both its military and civil aspects is an essential part of the nation's economic and political strength. As such it certainly deserves more detailed and intelligent consideration from both the legislative and executive branches of the government. However, the managers of the aviation industry cannot hope for much better consideration from the government agencies whose interests are properly shared with regulation of their business, unless they themselves make more of an effort to keep both the government and the citizens who elect it better informed on the vital issues facing aviation today.

The time for interminable bickering within the aviation industry has long since passed. Unless it is prepared to accept the full, disastrous consequences of its current policies the aviation industry had better start speaking loudly and clearly with a unified voice.

—Robert Minto

To further complicate the issue, nobody has advanced a single step in the direction of obtaining new negotiation procedures that effectively prevent profiteering on defense business but also permit legitimate business to operate efficiently.

Many of all these confined fiscal policies, most of them introduced in the name of alleged economic, is that they are costing and will cost the taxpayers of this country untold millions for which nothing tangible will be



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WHO'S WHERE

In the Front Office

Reg. Gen. C. Post Brown (RCAF, ret.) assistant to the president for special major units, Republic Aviation Corp., Farmingdale, N. Y.

Richard W. Miller, a director, Texas Products, Inc., Los Angeles, Calif.

Dr. John L. McLean, president, Walter Kidde and Company, Inc. (Walter Kidde Co.), division of Tapp Industries, Inc., 80, 8th St., St. Louis, Mo. Dr. McLean succeeds Robert V. Hagman, now, vice president long range planning, Tapp Industries.

Stephen J. Kelley, president, Telford, Inc., Springfield, Mass.

L. J. Brunetti, executive vice president and managing director, Walter Kidde & Company of Canada Ltd., Montreal, Canada. Mr. Brunetti succeeds C. K. McLeod, now, board chairman.

Arthur E. Connell, vice president general services, and Stephen D. Heller, vice president special test project, RCA Service Company, Inc., Camden, N. J.

Norman Fritschman, vice president, Boston Corp., Concord, Calif.

Wm. E. Brunetti, executive vice president flight systems, United Air Lines, Inc. J. G. Brown succeeds Mr. Brunetti as director of flight training. Also N. P. Ten are superintendent of flying and T. M. Flender, manager operations planning.

H. Donald Cameron, assistant vice president operations, Canadian Pacific Airlines.

Honors and Elections

Dr. James T. Gray, Jr., head of the Chemistry Section of Coastal Automotive Laboratories, Inc., has been appointed scientific advisor to the Air Force's Directorate of Research and Development, Washington, D. C. Dr. Gray is on leave of absence from the laboratory.

Carlo E. Baggio, president of Titan World Aircraft, Inc., has been elected a director of T. P. Higgins & Co. Incorporated, New York, N. Y.

Dr. Ernst Weber has been appointed assistant president of Polytechnic Institute of Brooklyn, N. Y. succeeding Dr. Hugo S. Rogers, deceased. Dr. Weber is vice president for research at Polytechnic.

Changes

Dr. Martin J. Gaud, director of research National Electronics Laboratories, subsidiary of Philco Electronics Corp., Washington, D. C. K. W. Hoover and H. R. Corbett, Jr., senior electronic research engineers are associates at Dr. Gaud.

Robert Barrows, project director solid engine, Research and Development Dept. Progression Division, Ohio Matheson Chemical Corp., Fair Haven, Ill.

Berry McPherson, is head testing gas gun mod. support systems, Taurus Air Craft Corp., Dallas, Tex.

William E. Baffin, Washington, D. C. superintendent, H. S. Porter Company, Inc., New York, N. Y. Mr. Baffin succeeds P. G. Connerman, now, transportation sales.

INDUSTRY OBSERVER

► Flying type aerial refueling battle system is being considered for Republic Aviation Corp.'s F-105 to give the supersonic aircraft a tanker capability. Gear consists of a retractable folding arrangement with a single drop-tipped tube (sketched below) from which tubes connected to external tank.

► Pogo High, induced heat source developed by Naval Ordnance Test Station for Side-winder missile target practice, is shot to 50,000 ft. by a muzzle using a Side-winder solid propellant motor. Parachute lowers the pod of slow-burning thermite mix which serves as an induced exotherm equivalent to foot engines of a pulse-powered rocket.

► Rolls-Royce Conway jet engine has exceeded its rated rating of 16,100 lb static thrust (AW June 30, p. 21) on test stand now at the Rolls plant in Derby. Military rating is 15,190 lb thrust. Commercial version (see schedule) for next Boeing 707 and Douglas DC-8 jet transports with the military version slated for an advanced version of the B-57C, F-4 Phantom II.

► Princeton case study for Canadian Tartar surface-to-air doctrine-based missile is under evaluation at Johns Hopkins Applied Physics Laboratory, Maryland. It is available, numerous similar doctrine. Navy Tartar is lighter than Tartar, requires about five avionic channels for search, track and fire control as compared with approximately 20 for Tartar.

► Radars made by Gecor to England are now being delivered to key NATO stations along the East Coast. Units have a range of around 300 mi., can detect and measure flight parameters of individual fighter planes well below Eastern Europe.

► Douglas Aircraft is building a mockup of an antimissile missile now under development incorporating a nuclear warhead.

► West German Air Force will flight evaluate the German 91F 19 supersonic fighter within the next few weeks as part of an overall study of available new high-performance planes needed to modernize its air arm.

► New aerodynamic modifications on Sud Aviation Vautour tactical bomber and night fighter for the French Air Force include leading edge extensions outward of pod-mounted missile and stub tail. Fourth production Vautour is being fitted with new-type tail, seventh prototype has been fitted with new leading edges. Both will be standardized on future Vautour, and leading edge extensions will be retrofitted on all production planes.

► Douglas Aircraft, AIDM advanced version of the AID which Navy's Bureau of Aeronautics decided not to build (AW July 1, p. 25), was to have been equipped with Martin's anti-aircraft Bulgep missile. For performance boost, the aircraft was to have been powered by Pratt & Whitney's new J3 which offers lower specific fuel consumption and is considerably lighter than the Wright J65 being used on the AID-2.

► Prototype version of Grumman Aircraft's Avon Marine high-performance aircraft (AW May 27, p. 28) has been designed by the Bethpage, N. Y., firm. Layout also has been made of a two-seat "dash-type" civil version of the aircraft.

► Grumman Corp. of Astoria, St. James, N. Y., probably will not attempt to obtain Civil Aeronautics Administration certification of its new Avon X1000-1 turboprop helicopter for civil use within 18 months after receiving required for a civil version. Military development and production program will delay certification attempts far at least that long. A company wants to use a commercial X1000-1, produced in lots of 100 to 300 might sell for as low as \$5,000 each.

► Side-winder antimissile missile equipped with avionic head instead of explosive warhead is being used for first flight training. If missile misses target, white flash results, and flash occurs with hit. Flashes are tracked from firing console and surface displays.

Defense '57 Expenditures

Defense Department expenditures during fiscal 1957 amounted approximately \$55.2 billion, some \$2 billion more than the administration had expected. Of this, major procurement and production accounted for \$11.5 billion, including \$8 billion for aircraft. \$7 billion for guided missiles. Operations and maintenance expenditures were \$8 billion, research and development, \$1.7 billion.

Committee Tangle

Some members of the House Armed Services Investigating Subcommittee are dissatisfied with the handling of its investigation of aircraft repair manufacturers. Chairman Ray (Iowa-R) told the subcommittee that USAF had wasted \$25 million on a contract with Corbin Wright Corp. (see page 56) and then jumped to a public hearing on an airborne contract with General Motors Corp. without substantiating the charges. Rep. Frank Duncan (D-N.C.) called the investigation "a headline hopping expedient" containing "an incomplete charge without hearing both sides." Duncan demanded that "we get on a subject and conclude a subject." Hatcher and his subcommittee are in a tangle with Corbin Wright President Roy T. Hatcher to review USAF records before going further.

The Subcommittee's hearing schedule calls for Ford & Whitcomb Aircraft Division of United Aircraft Corp. on July 29 and 30; Westinghouse Electric Corp., July 31; General Electric Co., Aug. 1; Continental Aircraft and Engineering Corp., Aug. 3; Ford Aircraft Engine Division, Ford Motor Co., Aug. 6; Licensing Division of Auto Manufacturing Corp., Aug. 7; Allison Division, General Motors Corp., Aug. 8.

New NACA Member

National Aeronautics Committee, for Aeromedical has a new committee member, Ross Allen, Washington T. House, assistant Bureau of Aeronautics chief for general staff and until recently BuAer general representative at Wright Patterson AFB. Allen, Allen House records Ross Allen, AFB J. Flying former assistant BuAer chief for field activities and now, large maintenance and technical officer of the Atlantic fleet.

Close USAF Audits

Air Force is taking steps to assure close audit review of forward pricing proposals of its contractors as a result of a General Accounting Office investigation of a contract for 195 F-84F aircraft with General Motors Corp. BuAer, Oklahoma Posture Assembly Division of Korea City, GAD charged that because of faulty cost data, there was a loss of \$17.4 million. General Motors refused to discuss profit of \$17.4 million. J. J. Powers, chief of GAD's Electronic Accounting and Auditing Division, presented a report on the investigation to House Armed Services Investigating Subcommittee. It was part of GAO's accelerated program of review of military aircraft procurement (AW) April 1, p. 181.

USAF was concerned that the costs paid were attributable to the failure of contracting efforts to analyze and evaluate effectively GM's forward pricing proposals. These USAF attempts to assure a reduced

have been inflated. General Motors has maintained that the adjustment of contract prices is effect a revision of earned profit rates is a matter for national consideration.

GAD is now raising a study in the to the legal validity of the negotiated price.

GAD charges that the GM price proposals on the two subcontracts did not reflect known variations in subcontractor price, labor, overhead and other costs.

Air Force Economics

Further attempts to beef up the economy is completed, as possible on current and future procurement situation will be made by Air Force at this week's Air Force Association convention in Washington.

Official theme of the meeting is the golden anniversary of the Air Force. Unofficial theme seems to be economics in the aircraft industry. Dr. Woburn, USAF Secretary James H. Douglas will bring subjects up to date on developments must be June 20 Pentagon conference with aircraft executives (AW June 24, p. 56). Officials of the Air Materiel Command and Air Research and Development Command will follow suit.

Belgium Bilateralists Suspended

Mounting concern in Congress over the Dutch and Australian agreements concluded by the State Department this year is believed to be one of the major factors behind last week's suspension of bilateral talks with Belgium. Legislation has been introduced in Congress designed to prohibit what nations have as a "partner" of U.S. air rights to foreign nations (AW July 15, p. 21). The Dutch and Australian agreements along with the German one introduced in 1955, are prohibited to violate terms of the United States civil air rules. According to the industry, it is that the foreign carriers received more benefits than U.S. carriers received in return.

It was reported that the Belgium sought additional routes to the United States, including routes to fly to the West Coast, and to Rome and points beyond.

Wilson Warning

Defense Secretary Charles T. Wilson has urged that "contractors be made aware" that unauthorized disclosures of classified defense information "is infinitely serious, are grounds for revocation of security clearance of offending individuals and, in extreme cases, for denying a company an opportunity to participate in future government contracts in the U.S. or for prevention."

This warning is a part of Wilson's reorganization of communications made last week by the Congress. One matter on classified information (AW April 27, p. 25). Classified information was noted in such a manner as to be classified in it, it is a "leak." But Wilson's emphasis is on the importance of the information specific individuals to classify without meeting the problem of unauthorized disclosure and classification—except to say that this shall be "irrevocable."

Rep. John E. Moss (D-Calif.) House Government Information Subcommittee chairman, and the implementation of the law has no feeling of optimism that the system will be any more being about a hearing of information which should not be classified but has been classified in the past.

—Washington staff

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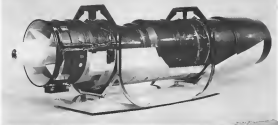
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Checking control cables prior to installation in the North American F-100 Super Sabre





GENERA IROQUOIS engine design features in the lengthened burner running along the lower portion of the engine (outlined white). This reduces all of the fuel and hot gases flow. Afterburners heat them, which are exposed, are naturally cooled by an annular surge. This will keep combustible gases out of the flow of air passing over the engine to the afterburner nozzle.

Iroquois Based on Supersonic Efficiency

Sacrifice of some subsonic performance was made to fit engine for extended operation above Mach 1.

By J. S. Best, Jr.

Malton, Ontario—Orenda turbofan engine developing about 23,000 lb. of thrust has been designed for maximum efficiency in supersonic flight at the expense of a slight reduction in subsonic performance.

The sacrifice is inevitable without variable geometry compressor and turbine blades, and it indicates that the Iroquois is intended for use in aircraft which fly a large percentage of their mission above Mach 1. Iroquois will power Aero CF-105 Arrow.

Afterburner Design

The afterburner has been an integral part of the design since its inception and burns thrust to over 30,000 lb. The Iroquois, which is the largest engine known to be in advanced development state in a Western nation, was shown publicly for the first time last week at its home plant.

Orenda claims a significant weight saving in the engine, which is approx- imately 20 lb. less, 4 ft. in diameter. It has been open, consequently, an unusual condition, and it makes extensive use of titanium and other new alloys.

Decision to design for maximum supersonic efficiency was made in September, 1971, when the project was

launched. It was estimated that by the time the Iroquois reached service, an aircraft would require supersonic speeds for more than a few minutes during combat. Therefore, the importance was well in length of subsonic cruise would be substantially reduced.

Orenda, a relatively small manufacturer with only two engine designs to its credit, was so concerned that its proposal for a very large engine could be mislabeled as premature that it put \$5 million of its own money into the original development effort. Fifteen months after this expenditure began the first test engine was running. Orenda did not receive financial support from RECAF until second engine was ready to run four months later.

The engine's development has now reached the stage that negotiations are in progress to license it for manufacture to the United States with General Wright previously mentioned as the licensee. Some engine data is available to U.S. manufacturers and many of their new aircraft designs propose to use the Iroquois-powered engine.

Primary decisions regarding good subsonic or good supersonic performance for an engine lie in the choice of the compressor pressure ratio. Low specific fuel consumption is attained by a high pressure ratio (and, incidentally, higher inlet temperature) at subsonic speed,

and by a low pressure ratio in super sonic flight.

In most engines designed for good subsonic cruise the pressure ratio is about 12. Some large engines designed for long use at supersonic Mach numbers (e.g. the Rolls-Royce Spey) the pressure ratio is about 6. The Iroquois is between these two figures so that subsonic performance is not too severely penalized.

Specific thrust, which is the other principal criterion for judging engine performance, requires a high turbine inlet temperature to reach a high value. At subsonic speed it is about Mach 9 aircraft speed is relatively low and low specific thrust is sufficient. Therefore moderate turbine temperatures can be used with high pressure ratios to give good specific fuel consumption.

Heat Problems

At speed increases, the ram effect of the air entering the compressor heats its pressure and temperature. High pressure ratios further heat the air and bring it closer to the turbine inlet temperature which is the limiting value for the engine. This reduces the amount of fuel which may be burned.

The result of this ram effect is that low pressure ratios are required at super- sonic speeds for low specific fuel consumption and maximum specific thrust. However, the minimum value of specific thrust falls off badly and the ram loss of air required for a given thrust gets very large. Airframe heating then becomes

attractive because it shortens specific thrust (about 18% at Mach 2.5) and cuts the volume of air required so that the engine frontal area can remain small.

Use of a low pressure ratio has the added advantage of reducing engine weight because it requires fewer compressor stages. The first stage design also cuts the number of stages because each speed can operate across the design point of its blades and require less efficient but more performance stage.

Engine weight was further reduced by the use of many new alloys and raising the design stresses of older materials through better refining processes. However, one need not be afraid that Orenda is set up for welding, machining and fabricating this material.

A typical direct weight saving through titanium is in a compressor stage which weighs 77 lb. with steel wheel and blades and only 31 lb. when made of titanium. Further indirect savings are reduction in stress transmitted to the shaft permitting lighter shafts and fewer bearings.

Therefore, use of titanium should result in greater weight savings than anticipated by direct material substitution.

Thrust-to-Weight

The thrust weight of the Iroquois should be around 3.5:1 lb. of the new estimates of variation in engine weight with thrust that have been made by Orenda engineers in technical literature has been achieved. This would give the engine nearly 3.5 lb. of thrust per lb. of engine weight which is reasonable when compared to known



Etendard VI Unveiled

First picture of Arrow doesn't Etendard VI show how similarity to Etendard IV gold model. Unlike Etendard IV, which was powered by Sorens Aero 1015-5, the Etendard VI is powered by British Cyclone turbojet rated 4,050 lb. thrust. Etendard VI, entered in NATO lightweight fighter competition scheduled to begin in September, has long low pressure ratio for landing on unpaved fields. Not proposed development of Etendard is a tandem fighter for jet engine after engine firing in Fagat Magister.

figures for various other jet engines.

Another novel feature of the engine is the method of suspension. It is attached to the fuselage at five points as compared to the more common three points. A series of links are used so that as radial loads are transmitted into the engine casing. The loads are all tangential and as a casing reacts these more effectively than radial loads it can be thinner and lighter. Distributing the loads into five points instead of three

also reduces load stresses in the casing.

Turbine blade cooling is probably being used on the Iroquois. Orenda has indicated that specific thrust is naturally improved up to Mach 5 through air cooling. This delays the need for afterburner use and helps the drive at moderate supersonic speeds.

Orenda has done considerable work in developing the before turbine blades needed for cooling. They have extra- thin blades for use up to 1,978° with air cooling, but their life is less than 50% that of a solid blade operating at lower temperatures. Orenda is also working on other methods of blade cooling which will be successful at about Mach 2.5 if specific thrust are to be raised above 3,000 lb. thrust.

Civil Applications

While the Iroquois is intended for military use at supersonic speeds in its design has strong arguments for its application as commercial transport with supersonic cruise speeds. Its basic compressor design would permit jet turbine operation at sea level and cruise Mach number through flight but line and compressor blade redesigns.

In contrast to some other engines of this type, the Iroquois has been designed in Canadian standards, which are virtually the same as those used in this country. The differences are in such minor items as methods of testing the engine for engine starting. The engine will also be manufactured by the same quantity production methods used in the U.S. therefore little or no additional design effort will be required for its use or manufacture here.

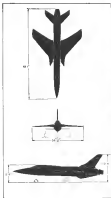
Defense Appropriations

House and Senate members last week approved \$31.3 billion in new funds for Department of Defense for fiscal 1972. This compares with the \$27.7 billion allowed for fiscal 1971. In January, the Administration originally requested \$36.1 billion for fiscal 1972. Key differences by the conference in the various field offices:

Appropriation FY 1972	Original Request FY 1972	Approved by House-Senate Conference FY 1972
AIR FORCE		
Aircraft and related procurement	\$6,346	\$6,180
Research and Development	719	661
NAVY		
Aircraft and related procurement	1,735	1,591
Research and Development	402	385
ARMY		
Research and Development	413	400



BELLY view of F-105 shows weapons bay beneath wing, pylons near tips also for stores. Main gun (below) folds into wing.



Intake, Speed Brake Design Are F-105

New York—Republic's F-105 Thunderchief, superior fighter-bomber, shown publicly for the first time at the Air Force 50th anniversary show last week, incorporates several design departures: swept forward intake ducts at the wing roots, clover leaf speed brakes and a blend of conical counter and leading edge droop.

The new model F-105, which is 61 ft 1 in. long, 39 ft 8 in. high at the tail and has a 34 ft 11 in. wing span, also incorporates an internal fin near its tail for additional cushion (top right).

Powered by a Pratt & Whitney J71 engine developing 15,000 lb thrust without afterburner, the F-105 can turn a hard weapons load internally or externally. It was designed under the weapons system concept.

Not felt on the ducts were to position the shock wave at the best angle for supersonic performance, but they allow enough depth to house the main landing gear in the wing instead of the fuselage as in other high performance fighters—Lockheed's F-104 and Chance Vought's F-8U, for example.

Republic says that the ducts addi-

Innovations

tionally reduce the turbulence of the flow against the tail to hold down buffeting.

Clover leaf speed brakes occupy the last 30 in. of the tail. They open into four petals with a sliding shield between them to form a solid conical brake area. Republic says the configuration provides more structural load, rig and at the same time more stability.

Curves at the root wing increases toward the wing tip to help prevent tip stall at high angle of attack. Leading edge droop provides areas of alternate design of conical counter to provide most effective operation for either cruising speed or supersonic speed. Conical counter reduces induced drag of a free wing at subsonic cruise without compromising supersonic performance (AW Nov. 26, p. 36). Horizontal stabilizer is one-piece all-flying type. Ventral fin is added for high-speed stability.

As Pratt & Whitney convention and Aerospace Engineers at Washington this week will include flight of B-70, X-15, Vertigo and static display of Lockheed X-17, Bell X-47, Hughes GAR-2A Falcon, Boeing Bomarc.



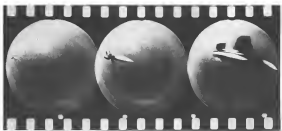
WING ROOT intake ducts, fin near tail (top) are unique design features of the F-105. Ducts provide maximum recovery at supersonic speeds and reduce turbulence of flow in tail. Fin short is for afterburner cooling. Actuation air bays are for clover leaf speed brakes. Wing incorporates conical counter.





Firebreak, Bloodhound Home on Targets

Two British missiles, the Firebreak (top) and Bloodhound Bloodhound (bottom) are caught at instant before impact with aerial targets. Firebreak fired from the Sea King, the Bloodhound fired from the Sea King. The Bloodhound was photographed from a distance of 100 miles in the air. It was one of two fired, one hit and destroyed target and the other passed within 100 ft of it. Firebreak, too, would have fired and destroyed second missile. Firebreak is infrared guided. Bloodhound, designed for long range, is powered by two Thor-boosted engines plus boosters for takeoff.



Russia Picks Tougher Satellite Orbit

Canfield, England—Russia will place its earth satellite in a satellite orbit at a height equal to the altitude. Professor Boris Ponomarev of the Soviet Academy of Sciences told a three-day international symposium here on high altitude and satellite orbits.

The meeting was jointly sponsored by the Royal Astronomical Society, the British Interplanetary Society and the Cranfield College of Aeronautics.

The Russians apparently are confident that satellite orbits will be provided by their program intent to overcome the disadvantages of a satellite orbit. U.S. plans call for an orbit in close proximity to an orbit plane in order to take advantage of the earth's rotational velocity.

Russia for the American choice was explained to the symposium by Milton Rosen, technical director for Project Vanguard.

Velocity Gift

"This earth rotational velocity is a gift, in so far as, of which the launch vehicle may take advantage to free itself from the burden of the earth's rotation," he said. "Obviously, the best condition would be to launch due east at the Equator, in which case the velocity gift would be 1,511 ft. sec."

Firing due east from the equator, said Cape Canaveral, Fla., would provide 1,540 ft/sec at an inclination of 25 deg. However, in order to permit observation of the satellite in observation in the temperate zone, the inclination specified is approximately 15 deg. That will give the satellite a rotation contribution of 1,170 ft/sec.

Rosen pointed out that what is required is a balance between velocity, performance and guidance problems—the more velocity available, the less guidance required.

"The Vanguard approach," he said, has been to maintain a substantial excess velocity capability and to hold the guidance to a minimum performance level."

The Russians firing from a site in the Soviet Union, which in any event would provide less of a rotational contribution, apparently have decided to pay up the rotational advantage in favor of a north-south orbit that will give much greater coverage of the earth's surface.

It thus will be possible to observe the Russian satellite from all parts of the earth with the exception of central areas of the Arctic and Antarctic. Ponomarev said an idea has been brood for the first Russian launch, the cost of attempts to be made will de-

pend on actual success in achieving an orbit, he said.

Ponomarev headed a five-man Russian delegation to the meeting. He also set Soviet plans for firing a total of 127 high altitude satellites during the International Geophysical Year. These are to be launched from sites in the Soviet Union in the Arctic and in the Antarctic.

Earthlings are to be made between now and December from the Soviet Union track between latitudes of 50 deg and 60 deg north. Another 48 will be made next year.

Rocket Firings

Twenty-five missiles will be fired next year from Plesetsk Launch 50 deg north latitude and 50 from the Arctic in the area of Murm, between 60 and 60 deg north latitude.

He said the Soviet satellites will reach heights up to 125 mi. They will carry instruments designed for release at high altitudes and also will be equipped for maneuvering.

One of the most interesting papers of the symposium was presented by Lt. Col. J. F. Rosen, of the Research Office of Air Research and Development Command. Col. Rosen looking ahead to manned satellites, suggested that one of the great psycho-physiological hazards of satellite travel might be the lack of communication from psychological activity and lack of sensory stimuli.

He noted experiments which have been carried out concerning the sense of information reaching an individual through external sensory patterns. These included long periods of dark-

ness, silent rooms and in well-lit rooms in which a beam observed all significant sounds.

In all cases, sooner or later, either in a few hours or in a few days, the subjects began to show signs of sensory deprivation fatigue to show weakness," Col. Rosen said. "They were subject to blank periods when they could not think and became depressed and sad."

Subjectively the most distressing sensation was the appearance of hollowness. Starting with simple dots of light, lines and geometric patterns, they progressed in time were in into more and more complex and finally integrated, resembling those. They would not look like scenes from a motion picture. However, the images could vary and tilt as necessary in a disturbing fashion."

The ARDC official suggested that when there is too little information flowing into the brain from sense, or from recording events on the radio world, the brain tends to overcompensate, producing patterns which are not actually external patterns.

Misinformation Prevention

Hallucinations and other side effects can be prevented, he said, providing there are sufficient reinforcing links and that there is the outer world for the brain's reinforcing mechanism to be able against what he called constant "inner bombardment."

Col. Rosen said there is a very real psycho-physiological hazard in the operation of a satellite vehicle for a prolonged period.

"If prolonged sensory deprivation is to be combined with darkness and lack of meaningful information from the environment within the vehicle, mental breakdown is likely to be expected in some cases in a few hours," he warned. The manned satellite must be designed, he said, so that the human operator is constantly occupied with meaningful stimuli and significant tasks. E. J. Bonner, Soviet chief engineer of Cosmonauts, also made points and non technical director of Cosmonautics, outlined for the meeting some of the problems faced in the development of large man-made life did not mention the Altis in case but gave considerable amount of what he said stemmed from experience with the subsequent Soviet satellite launch.

Bonner said that for optimum performance, the large vertical launchers, satellites, the driver should not be any much larger than the heaviest weight. He said the trend for thrust-to-weight ratios in modern launchers is downward and initial acceleration of less than

Soviet Tilt

Moscow—Russia Air Force's new official magazine, *Kosmos*, Soviet Union, has been sharply criticized in the Soviet Army's *Kommunist* (Red Star) in an apparent case of public display of inter-service friction.

Red Star, the traditional military voice of the USSR, went out of its way to point out that Soviet Air Force, which is still less than a year old, is poorly armed, frequently outmanned.

The Army paper published a letter from a Russian Air Force major who said Soviet Air Force failed to identify personnel with their proper units, reported and carried in newspapers, and indicated articles moved from its news agencies, and attributed negative interpretations to some officers.

Both Soviet Aviation and Red Star are official newspapers of the Soviet Ministry of Defense.

17G are the rule. He said it could be as slow as 17G.

Calling for slow low thrust ratio in the performance design phase is fraught with danger," he warned, "since an aerospace weight growth might well jeopardize the final product beyond repair."

Solid Propellants

Recent denials of the idea that solid propellants will ever be competitive in the larger missile field. High cost, variable combustion duration, weight and handling difficulties will preclude the switch from the larger number of solid.

Cost advantage of the anhydrous-carbon combination is difficult to measure among the liquid propellants, Bennett stated. Unless the cost of high specific impulse propellants comes down several times from what it is today, he said, no reason will result from their use in the first stage of a missile. Only the one, not the cost, could be reduced, he pointed out.

"The so-called super-propellants should, therefore, be reserved for second and third stages of multi-stage vehicles," the General official said. In this case the increased cost of the propellant in the upper stages will be more than compensated by the reduction in size and cost of the first stage."

Bennett suggested that the question of residual propellants is a serious one since unusable propellant left over at launch would have been a serious setback.

He said three primary sources of re-

sidual propellant at launch are:

- **Propellant pumps** requiring too high a inlet pressure. These are unacceptable since they limit a high column of liquid ahead of them at launch.
- **Reservoirs of propellants** in the tanks which cannot venting at the outlet. This can be solved with suitable baffling.
- **Failure to fill tanks** to the correct level or deviation of the metering device into from the required value, causing one of the two propellants to run out before the other. Soluble devices to correct the mixture ratio in flight in order to achieve satisfactory engine life at both take-off and on challenge, Bennett said.

Structural adjustment of large ratios can be a major problem; the General engineer noted, pointing out that weight saving cannot be achieved without loss of rigidity. Since higher strength alloys do not have as much as Young's modulus, leading frequencies go down and begin to approach the zero frequency of the missile.

The price of course, current data push between angles or irregular rates to provide attitude and those due to attitude heading determination. Rate gyro are particularly undesirable.

Gyro Solution

Bennett said the problem generally can be solved by passive heating of the gyro and by designing the control system in such a way that they will filter out the undesirable frequencies. If this cannot be done, he said, spin rate gyros must be used.

Propellant sloshing also can have a considerable effect on control, Bennett said.

Chief Aerodynamicist W. F. Hilton of Armstrong Whitworth Aircraft proposed a unique solution to the problem of sloshing of stored propellant into the earth's atmosphere. He set forth principles of a vehicle designed to protect the crew from heating of feet by placing them and other parts of the vehicle in an "aerodynamic room."

Lift Drag Ratio

The vehicle was said to offer many more drag associated with maneuvering lift and also to have a low drag. It was lift for total launching. Since the lift level should be directed towards the earth on ascent, in order to avoid the trajectory around the earth as much as possible. Hilton said the vehicle would be pushed down by oxidant aircraft standards at all speeds above 1000 ft/sec. At the speed it would require a due rail to remove the lift.

He suggested a spin-stabilized or solar platform, somewhat similar to a "flying saucer," noting that as solid fuel is too low aspect ratio it also of less a good shape for penetration of the dense and viscous payload environment.

The aerodynamic criteria would be created by designing the "best" side of the space vehicle in such a way that it would be impossible for the air flow to turn the corner completely in attempting to fill up the vacuum on the "cold" side of the saucer.

USAF Fires Atomic Air-to-Air Missile

By Richard Swenson

Murphy, Nev.,—Firing of the first atomic warhead as a test round here culminated in a new era in aerial warfare capability for USAF's Air Defense Command, as ADC commander Lt. Gen. Joseph A. DeLoach declared that such missiles already are on operational status at a number of U.S. bases.

While the Douglas M61 Genie is not now being flown routinely, Gen. A. DeLoach said, it has been flown in missions at various ADC stations and should the need arise, it can be taken from storage, assembled, loaded and made ready for combat within a matter of minutes. Earlier descriptions of the Genie was being fired.

The missile fired here was a modified version of the solid propellant, free-flight rocket, differing from previous models in that launch from the aircraft and warhead detonation were accomplished in ground controllers in the Texas Flat site control room via a telemetry link. Launch criteria including weight and warhead detonation is a few seconds before launch. Plans used in the test was an F-80.

Primary purpose of the test here was to gain operational data for the Air Defense Command—information as accuracy of damage caused aircraft could be expected to sustain at various distances from the blast and amount of radiation—and to help ADC develop proper plans and techniques for atomic air defense.

Warhead was detonated at slightly more than 15,000 ft above the test site, exactly over the heads of 20,000 service men ADC headquarters officers and one AEC observer, who stood as positioned at General's Zone to test the potential danger to citizens and property which might be brought out of the weapons in combat use.

The M61 itself is approximately 180 in long, weighs in diameter has four conventional shaped fins with sloped leading edges, horizontal straight tips and vertical trailing edge for free flight stabilization. USAF officials explained that the free flight choice was made to simplify construction, increase reliability. On the M-60 it is carried on Douglas designed and built go-lows, subinstruments of which indicates the missile is heavier than conventional weapons of same type due to nuclear materials and electronic equipment.

Propulsion is furnished by Aerojet solid propellant rocket motor which projects mass for some 9,000 ft in power flight. On this firing, the missile traveled an approximately equal distance expected before the ground con-



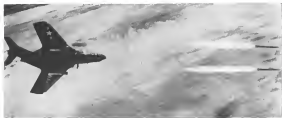
AEROJET designers working point of Genie about 15 sec from detonation point, which was at an altitude of about 15,000 ft; proposition of this rocket's Atomic Warhead photographs taken at the test site earlier. Warhead is in final stage.

trolled warhead detonation. While test officials had assumed that the rocket would be detonated between three and five sec, after launch, indications were that flight time was slightly more than five sec but less than the necessary.

Yield estimate of the weapon was approximately 10 tons. That was not the first detonation of the M61 warhead, which occurred during the 1955 Nevada tests in an air drop and showed that the warhead could be easily aimed.

Test experiments were conducted during the "John" test, AEC's name for the rocket detonation, one of three for military efforts for Air Defense Command.

Gen. A. DeLoach's comments here to expand its capabilities is a number of ways. Possibility exists that a close run race was set off against an enemy weapon being carried by other planes. Slightly further out, in the event of a nuclear weapon is not covered by the enemy, the target can encounter structural failures, or even further out, get back into some form of attack to precipitate other problems for attacking.



F9F Fires Zuni

Two Navy Zero Five-folding air-torpedo Mark 34 rockets are fired by Grumman F9F Cougar (AFW Mac 11 p 36). Solid propellant Zuni is 9 ft 2 in long, has high velocity, can be used as air-to-air weapon against heavy bombers if proper launch is used. Navy has awarded Hughes Aircraft Co. a \$2 million contract for pilot production of aluminum metal motor tubes for Zuni. Hughes Douglas worked with Navy Ordnance Test Station engineers to determine that rocket tubes of this type could be made in cold firing process. Hughes Douglas also is making metal parts for motor used in Silvermaster, Navy's advanced guided air-to-air missile. Aircraft can carry up to 48 Zuni rockets in compact, inexpensive launchers.

microfit. In addition, robot-on-robot attacks may be caused by an enemy robot, resulting in loss of motor sensors, control, torquing, etc. Enemy robots also may be badly shaken by "botch induction sickness" as a result of seeing other players in their attacking force vaporized by bats or close combat.

Air Defense Command is caretaker of MB-15 stored at its bases. It has sent its own personnel to AEC for training in handling of nuclear materials as well as handling, assembling and loading of MB-15. Additional core training is conducted with models of the rocket at Air Defense Command bases where it is operational. It is planned that practice firings of nuclear but nonradioactive rockets will be given soon.

Although storm sockets will be the primary plastic attachment, scuffit will be able to carry GJR-type weapons such as Fukusa or storm cannons, for backup.

Obviously, the MB-1 will be fired and detected by Hughes MC 12 fire control system, a modification of the E-4 used on F-4H aircraft. Although initially intended for land-to-land cruise attacks, the missile demands flexibility in attack from any quadrant, and the fire control system modification



Rortmac's F-35B Thunderbolt, newest fighter-bomber of the U. S. Air Force, is one of more than four types of turbine-powered aircraft using standard Hamilton Standard equipment. Superior engineering, research, and development, and years of experience, stand behind Hamilton Standard's leadership in production for outstanding aircraft—jet or propeller driven.

WHICHVER MAIN FUEL



Engines • Turbines • Air Conditioning Systems • Fuel Controls • Valves • Pumps
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TWO GARR 2A Falcons of a salvo of three fired from a Canadair F-4E in USAF test at Holloman Air Development Center, N. M., strike a Marine TM-61A photosounder. First Falcon is a split second from impact in top photo of sequence. Second photo shows instant impact of last Falcon on tail of Marlin. In bottom photo and the last Falcon is approaching the target. Infrared guided Falcons and solar guided types can be used on almost all weapons. Range of GARR 2A is more than the miles from launch.

missile, since the GARR 2A is the target before launch. Wide-angle of the infrared eye permits launching from the to the side of the target, allowing the a variety for tail attack.

GARR 2A is not directly comparable with Navy-developed Sparrow missiles which USAF has ordered for use as far Defense Command as the F-104 Starfighter. Sparrow was described as a simpler, less expensive infrared missile for use with fighters and Falcons as a more sophisticated infrared system for attack of air-sea targets (P 101B) ranging on all a either on target or on a with more versatile fire-control system.

Infrared Falcons is 33, and one-half ft long, in tail section on, in diameter and weighs slightly over 120 lb—about the same dimensions as the GARR 2A and 1D.

Infrared nose is only difference between 1D and 2A.

Shipping container for GARR 2A carries three missiles in containers. And direct only in-flight, and in direct temperature limits 400 to 1100°.

Red Dean Missile Revealed by British

London—Evidence of Red Dean, a new Vulcan Avenger, arrived in the United States was revealed by the British Aircraft Corporation in a list of missiles to be on display at the SBAC Farnborough exhibition in September. Vulcan gave no further details.

SBAC said several restrictions have been lifted sufficiently to enable the British industry to demonstrate for the first time a "launch" concept of attack in the missile field.

There will be a special guided missile enclosure at the exhibition. In addition to the Red Dean, missiles on display will include:

- **Ex-Barracuda Firebird**, an anti-aircraft infrared missile which is to be fitted to the Gloster Javelin, English Electric P1 and the Blackburn Sea Venom.
- **Bombardier Bloodhound**, guided to an weapon ordered by the Royal Air Force.
- **English Electric Thunderbolt**, an order by sub-aerial command and under development for RAF.
- **Avonmouth Whitehead Sea Slug**, deep-sea missile ordered by the Royal Navy.
- **Fairy Firebird**, RAF air-to-air training missile.

Test and target missiles to be displayed include the Bristol Bloodhound, Sea Slug, and Avonmouth Firebird, powered by an Avonmouth Avon engine.

Aircraft taking part in the Farnborough show will include the English Electric P1A and P1B, the Fairey Delta II, and the Avonmouth Sea Slug SR 51 rocket-propelled interceptor.

Hurley Offers House Committee Stronger Industry at Less Cost

By Katherine Johnson

Washington—Ray T. Hurley, chairman and president of Curtiss-Wright Corp., has volunteered to serve as a congressional consultant to Congress on a study of the aircraft industry and, at the same time, "tune hundreds of millions of dollars."

Hurley made his offer to the House Armed Services Committee, which is studying the industry at the opening of the group's investigation into profits and procurement policies of 17 major aircraft manufacturers (AW Jan. 1, p. 26).

The three main parts of the plan, Hurley said, would be:

- Increase profits.
- Increase company-owned facilities.
- Give military procurement officials "more freedom of action" in the use of funds and thereby make them accountable for "the use of funds."

Major Savings

These three inter-related steps, Hurley emphasized, would pay the war for itself in the aircraft industry. "It is important to make them work," For Curtiss-Wright, he said, "cost savings about 90-95% of the price of the engine."

A 1% reduction of the amount would be a positive saving for the taxpayer than completely eliminating all profits on military business. In the world of business and government to exist, two main purposes are being placed on profits and cost savings on cost reduction. It is one to talk about profits, it is a popular subject, but it does not require the cost and know-how that goes into well-planned cost reduction programs.

Hurley highlighted the present policy of "An Air Force in being" that is becoming obsolete by known-and-the theory that we do not need an industry to support it."

He also presented that "we are now returning to the position of having 70% of the military engine capacity in one company (Pratt & Whitney Aircraft) since war when an emergency supply source, we will be unable to supply the engine needed, and the engine will lack the program that is the natural result of competition."

Since the government can only have its facilities after the fact, he said, it is always late and unreliable cost reports on delivery schedules of major aircraft procurement. He repeated that at Curtiss-Wright, he said, "we are going to get a government-owned big

contract plant into possession of its full-scale plant because of delays, holdups, cancellations and mismanagement and requests for unacceptable reports and expenditures."

If manufacturers were presented self-sufficiency to supply their own up-to-date facilities, Hurley maintained, "a superior product at a lower cost" would result.

In reply to a subcommittee questionnaire, Curtiss-Wright reported for the five-year period, Jan. 1952, to Dec. 31, 1956:

- Net worth of the corporation increased from \$121 million to \$153 million.
- Total government business increased from \$274 million in 1952 to \$383 million in 1956.
- Total dividends paid amounted from \$50 million in 1952 to \$19.6 million in 1956. For the years between, the dividends paid totaled—1953, \$6.1 million; 1954, \$8.9 million; 1955, \$14.1 million.

Contributions to their paid to date, professional or personal services rendered by the corporation amounted from \$68,799 in 1952 to \$10,299 in 1956. The largest payment in cash was made to Aircraft Industries Area—1952, \$5,863; 1953, \$6,666; 1954, \$5,858; 1955, \$6,432; 1956, \$8,451.

Wright Aeronautical

The government business of Curtiss-Wright's Wright Aeronautical Division for the five-year period was reported:

- Engine contracts totaled \$1.6 billion, on which payments of \$1.4 billion were received by the end of 1956. Profit averaged 13.2%.
- Research and development contracts totaled \$146.6 million, with payments received totaling \$93.3 million.
- Space parts, overhaul, service and repair contracts totaled \$181.8 million for the five years, payments received amounting to \$207.6 million.

Meanwhile, Air Force Secretary James H. Douglas declared a contractual relationship to Curtiss-Wright for the overhaul of 390 J47 engines at the Ohio, Ohio, plant of Studebaker-Packard which Curtiss-Wright leased to being "found at the time it was made" (AW Aug. 18, p. 18).

Rep. William Hens (R-Ill.), ranking minority member of the subcommittee, has reportedly estimated USAP for letting the contract in July 1956 at a time when it was clear that the J47 overhaul workload would be cancelled and that the engine would be

phased-out. The overhaul already being performed at two USAP bases and at the Evinrude, Ohio, plant of General Electric Co. The Curtiss-Wright contract already cancelled in a contract at the General Electric plant.

At the time of the Curtiss-Wright contract, Douglas said it appeared that the facilities at the two USAP plants and the General Electric plant would be needed for other engine overhaul, and that the "subcontracted to the production for another J47 facility," he added.

"B-1, KC-115, F-105 and F-100 aircraft production was at a maximum," Douglas reported. "The J47 engine was at the USAP plants which also overhaul J47 engines. At the same time, the B-57, F-104 and J47-304 production contract indicated a buildup of General Electric built J79 engines."

However, because of cancellations and statements in the aircraft program, Douglas said, "an overhaul program for the engine needed the re-equipment. This situation was accomplished by doing more program reduction."

Overhaul Costs

The unit cost on overhaul of J47 engines at the Curtiss-Wright plant during 1957 was \$5,486. Douglas reported. He said the unit cost on the 300 overhaul Curtiss-Wright was placed during fiscal 1957 was \$5,300. \$5,574. He estimated that the unit cost of the overhaul of the Curtiss-Wright J47 engines "will be competitive at approximately \$6,383 per engine." Douglas told the subcommittee that Air Material Command has been notified that follow-on contracts in the Ohio facility are to be based upon "the ability to attain a competitive position and provide satisfactory performance."

Rep. Edward Herbert (D-La.) also made the subcommittee, but charged that USAP "seems to let the Curtiss-Wright contract in order to 'load out' Studebaker-Packard and that the debt in question from General Electric has cost \$15 million (AW July 31, p. 13). Herbert said that the contract is a complete seizure." He has been furnished USAP records to review. Air Force costs involved in the transaction. Several subcommittee members also intend to subpoena him to charge.

Hurley responded by saying that he has been told by Studebaker-Packard that Curtiss-Wright would be able to do the overhaul. He said that the contract was cancelled in July 1956 at a time when it was clear that the J47 overhaul workload would be cancelled and that the engine would be

phased-out. The overhaul already being performed at two USAP bases and at the Evinrude, Ohio, plant of General Electric Co. The Curtiss-Wright contract already cancelled in a contract at the General Electric plant.

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AIR TRANSPORT Gen. Baker Assumes Capital Presidency

Carmichael will direct policy as board chairman; financial expert Baker plans tighter economy.

By L. L. Dety

Washington—In a surprise action, Capital Airlines board of directors last week elevated J. H. Carmichael to chairman of the board and elected USAP Maj. Gen. David H. Baker to replace him as president and chief executive of the company.

His new position shows advancement from the Air Force was announced earlier this month, was known director of procurement and production for the Air Materiel Command (AW July 3, p. 25). Described as a "great challenge," Gen. Baker has led his long career as a financial and procurement expert for the Air Force retirement benefits office at Westfield, Mass., and now Capital the following day.

Under the new arrangement, Carmichael will handle all public matters of the company, and Gen. Baker will direct all activities pertaining to the operation of the airline. A company spokesman told Aviation Week that the change is no way reflects Carmichael's role as director of the airline.

He said the move was made to strengthen management and expand the organizational structure of Capital to meet the problems of the jet age.

Carmichael Succeeds Hens

Carmichael will succeed the present chairman, George R. Hens, who was chosen chairman of the executive committee of the board. Hens has been long associated with Capital as one of the company's major shareholders. He replaces Charles Marchison who will remain a member of the board and legal counsel for the airline.

The airline's management as a consequence change in its present equipment program, although plans to expand its present fleet of 75 Vickers Viscounts by an additional 15 have been dropped, and the order for 14 Lockheed L-1049 Hercules has been delayed (AW May 13, p. 79).

Capital still intends to re-equip its fleet with new jet aircraft. The airline's management and strategy needs for additional financing including a \$60 million bank loan can be completed. One of the primary purposes of the management reorganization is to bring the company's financial structure into a more stable position.

Last month, the airline covered its 1957 operating estimate downward from an earlier prediction of a \$51 million net profit to an estimated \$3.5 million loss. Traffic and accounts have shown a spectacular rise since the introduction of the Viscounts, but heavy interest in equipment financing, which are currently planning the airline, which are increasing equipment costs are increasing loss of \$2,801,000 and a net loss of \$1,286,951 in 1956.

An expansion toward aircraft security became apparent during the first few months of 1957, however, with the airline cutting its operating loss, in close to break at a profit of \$1,286,951.

In May, the airline reported a net profit of \$168,000 for the month after a net loss of \$31,738 in comparison with a net loss of \$24,038 in May, 1956 after interest charges of \$188,554.

Equipment Purchase Hints

Operating revenues for the month increased to \$5,312,000, a 55.5% increase over the previous May. Operating expenses were \$7.8 million or 42% higher than expenses during May, 1956.

Depreciation expenses related to the Viscount deliveries since May, 1956, accounted for \$1,211,000 of the \$1.8 million increase in operating expenses. Nevertheless, the airline's breakdown last month has shown a sharp rise and expenses must be brought into a

closer alignment with revenues before Capital can undertake a major expansion program. Equipment purchase rates were stated under analysis covering the regional order of 50 Viscounts and related items at the time of this delivery. Such rates are possible in future periods and have been recorded at the time rates of \$2.50 per pound. That is possible in monthly installments over a period of five years and less interest at 11% above the bank of England interest rate ruling at the time of purchase. The interest rate is set to exceed 64%, the amount the airline is now paying.

Viscount Deferred

Last year, the airline borrowed \$12 million through the issuance of 41% convertible subordinated debentures to finance the expanded operations of the company. At that time, the subordinated common stock was increased from one million shares to two and one-half million. Later attempts to negotiate a \$80 million bank loan to finance new equipment failed to materialize.

Carmichael has strongly defended the Viscount and his reports said that the basic issues related to the purchase of the company's DC-8-10s and Constellation 304s are off setting the profits earned by the Viscount.

The airline, however, has recognized the need for a larger, better aircraft to compete with the Lockheed Constellation line in 1958 or early 1959 on its Chicago-Washington, New York, Chicago and New York-New Orleans routes. Both Eastern and Overseas

Fares Increase Setback

Washington—Decreases of the 65% passenger fare increase set by news U S truck airlines was recommended last week by the Civil Aeronautics Board Bureau of Air Transportation.

In a bid to the Board, the Bureau Council said some of the more drastic fare hikes that it proposed and projected earnings—above what the standards of the Civil Aeronautics Act—such as to require an industry action in fare paid per determination of the rates in the General Passenger Fare Investigation. The Bureau Council added that an analysis of economic considerations shows that the current rate of increase in revenue expenses is adverse to the airline industry and, therefore, the Board should delay the proposed increase.

The same action applied for a 9% increase on the basis that public rates reflecting between operating costs were increasing at a greater rate than operating income. Airlines claimed that the industry could be severely damaged if the level of earnings continued to allow for white traffic to continue to increase.

Airlines proposed by the Bureau as United, Northwest, Eastern, Capital, Western, Delta and Trans World Airlines. The Board has scheduled next sessions on the case for Wednesday.

of Capitol and compare with Capitol have entered the Electro.

Caninehad announced the purchase of 20 Vincennes in 1914. The order was later canceled, and the turbo-prop engine was investigated in 1916. In 1955 the move was taken primarily to strengthen Capitol's competitive position against the Cessna 140, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

The airline's note elsewhere was not statistically improved in 1955 with the addition of several new routes to the Central American area and the lifting of certain operating restrictions on its established routes.

Caninehad, however, has termed the present route pattern the "core" of Capitol Airlines and is planning a vigorous program designed to achieve operating terms from Detroit to Florida in an attempt to introduce a long-haul, high density traffic segment to the airline's system. One airline spokesman described Capitol as the "largest feederline in the industry" and said larger routes must be added to the existing pattern if substantial net profits are to be realized.

Caninehad was elected president of the company in 1945 when the airline was threatened with bankruptcy. By introducing an airline expansion program, he was able to move the company into a strong financial condition by the next year. A former editor of Capitol, he has been associated with Capitol and its predecessor company in a managerial capacity since 1946.

The route expansion and refinancing program will fall under the direction

of Caninehad based chairman while Gen Baker will be charged with bringing about more efficiency and stronger economic control of the airline in its day-to-day operations. Gen Baker is an expert of efficient management and a disciple of Harvard Business School principles.

He is 49 years old and a graduate of West Point. He was graduated from the Air Corps program and advanced flying schools in March, 1932, and flew the air mail between Newark and Cleveland at the time the air mail contracts with private carriers were cancelled in 1934.

He was graduated from the Harvard School of Business in 1941. The World War II service included duty in rear echelon of the Ninth Air Force Service Command and in 1946 he was named to the faculty of the National War College in Washington.

Later, he was named Air Force member of the Joint Logistics Plans Group in the Office of the Joint Chief of Staff. Before his retirement from the Air Force, he served as director of procurement and production of the Air Materiel Command. He is generally credited in the office who directly oversees the airline a year ago that developments in facilities and programing would be required to meet the shift in emphasis from military aircraft to airline production.

In a statement to Capitol's employees, Caninehad said, "Having known Gen Baker for several years, I know you will share my conviction that his election marks another forward step by Capitol and significantly strengthens the Capitol organization for the task that lies ahead."

Infrared Proximity Detector Set for Early Flight Test

Los Angeles—Aircraft proximity warning indication which uses infrared, ultraviolet or motion range were some of the new proposals considered here last week by defense agencies attending an Air Transport Association sponsored meeting on the air collision problem.

The new system evolved. •Raytheon Aircraft General described a 30 lb. (unclassified weight) infrared based PVI which it believes can detect and display position of other aircraft at ranges of 2-4 miles, depending upon aircraft type and atmospheric conditions. Raytheon consists of a small IR scanner for 180-degree search coverage at airplane's own altitude plus two passive IR detectors which provide upper and lower hemisphere protection.

Aircraft General hopes to flight test

prototype system within six months.

•Hawthorne Sidman Electric, which has been studying ultraviolet techniques, suggested the possibility of a cooperative type PVI and collision avoidance system. Each aircraft would carry a directional ultraviolet scanner and an associated ultraviolet receiver. When ultraviolet energy was received from a nearby airplane, ultraviolet beams would reply in pulsed radio ranging. Altitude, course, speed, and rate of climb for one in collision would also be computed. Sidman says ultraviolet is not subject to background noise which can produce false alarm with infrared system at altitudes under 40,000 ft.

•Nuclear-Aircraft Instruments Mass. is studying Co suggested the possibility of cooperative PVI in which aircraft

searching source is installed in aircraft tail together with nuclear radiation detector for spotting collisions from nearby aircraft. Nuclear counter's low cost would permit installation on light planes not equipped with efficient detectors, giving position against false triggered aircraft. Detection ranges of several miles appear feasible, but company has made only preliminary studies pending evaluation of industry interest.

Radio Corp. of America suggested results of its study of the possibility of using existing radio beacon for PVI purposes. Modification of radio beacon, use of mobile, ground-based radio beacon, or a combination of the last (short of solid PVI) push set by ATA and the industry, RCA said.

Service to Mexico Begun by Eastern

Mexico City—Eastern Air Lines last week made its first scheduled appearance here, 11 years after first receiving U.S. authority to visit the flight.

Using Douglas DC-7Bs, Eastern inaugurated one-way flights from New York to Mexico City and Mexico City to New York with intermediate stops in San Orleans. Scheduled third class fare for the flight is seven hours, 30 min., including a one-hour, 15 min. layover in New Orleans.

The airline first won U.S. authority for the route in 1946. The authority was later revoked by President Truman and later reinstated by President Eisenhower after the signing of the Mexican bilateral agreement in March (AW March 18, p. 45).

The airline's scheduled competition on the route is Aeromexico, which hopes to begin service by the middle of August if it can finish the necessary equipment—probably Lockheed Super Constellation.

Aeromexico also has been designated to fly the New York Washington-Mexico City nonstop route granted under the bilateral flight plan to begin service over this route tomorrow. This will be the first two of five Round Bahamas Airline Company's first on order.

Eastern also runs Aeromexico's competition on five non-Eastern and Pan American World Airways have been waging a vigorous battle for the route, but neither officially has and in Washington last week were giving Eastern the simple task. Civil Aeronautics Board's recommendations in the case are in the Works House but last week for final approval.

First U.S. line to begin service here under the bilateral agreement was Western Air Lines. Western inaugurated one-way, nonstop flights into the capital on Feb. 19.



HO4S HO4S helicopter transport designed by Sikorsky Brothers has long struts across top of fuselage, retractable (the wing and tail) and glider panels on top and at both sides of the cockpit for good visibility when hovering. Plans will be produced as plant on the edge of Moscow's Central Airport.

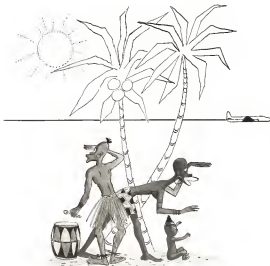
New Russian Transports Fitted to Aeroflot Needs



HEAD ON VIEW OF AN-10. Ukraine shows drag quality during display at Moscow's Vnukovo Airport. Ukraine is designed for 100% for operations on the unimproved grass fields that are the main civil airports for many cities in Aeroflot's route pattern. Note thick wing root struts used for load storage.



SIZE of Ukraine designed by G. K. Antonov is shown in contrast to Aeroflot explosion standing near the nose and tail. Note the visible glider panels on the top and sides of the cockpit, external power source construction just aft of main landing gear and the control fin under the rear fuselage.



Around the equator 1,800,000 times!

Passengers on the scheduled air fleets of the world last year logged 45 billion miles—enough for one passenger to fly around the equator more than a million and three-quarter times! This figure represents a gain of 16% over total passenger miles flown in 1954. And this amazing record is expected to be broken again in 1957.

As more and more people fly more and more often, new and better planes are being developed

to meet them. To keep these planes flying, operators know they can rely on Esso Markets for the finest in modern aviation fuels and lubricants—perfected through years of research—and for the finest in uniform, safe and efficient petroleum services along the airways of the world.



AVIATION PRODUCTS

UAL's Revenues Climb While Profits Drop

Chicago-based Air Lines last week reported a 5% increase in revenues for the first six months of 1957 but a sharp increase in operating expenses resulted in a decline in net earnings from \$5.7 million for the same period of 1956 to \$2.9 million.

W. A. Patterson, United president, said operating revenues amounted to \$153 million (estimated to \$126 million for the same period of last year, but that earnings per revenue dollar rose 11 cents in contrast to 5.6 cents a year ago.

Sales of single aircraft produced gains of approximately \$1.5 million as against \$737,000 for the same period last year.

Expenses climbed from \$115 million during the first six months of 1956 to \$126 million in 1957.

Operating income amounted to \$3.8 million for the six months ended June 30, 1957, a drop from operating income of \$10.9 million reported for the same period in 1956.

Slick Establishes Aircraft Sales Unit

Dallas-Slick Airline moved into the aircraft sales business by establishing a separate division to buy and sell airline transports.

If the new sales office works out well, it will mean a further broadening of the large line's base of operations.

The carrier already implements scheduled cargo service with special contract and charter schedules and with regular scheduled stock order contract with the Air Force.

In establishing the new division, Slick points out that, as the major airlines began to convert to turboprop and turbojet equipment, many of their present piston-powered transports will be placed on sale.

Slick hopes to find a market for these aircraft among the smaller domestic carriers and among younger airlines of foreign nations.

"We feel there is a need for Slick's services in this aircraft market," Hensel Hiett, vice president of operations and maintenance, said in announcing the new unit.

"Through our own aircraft needs, we have become familiar with the equipment used, through our contacts on a world wide basis, we are familiar with the potential customer."

In view of the fact that Slick is getting five new DC-64 airplanes next year and that Douglas is discussing a

AIRLINE OBSERVER

✈ Northwest Airlines has entered into an agreement with Civil Air Transport (CAT) to operate flights between Hawaii and Hong Kong on a once a week basis, after Aug. 1. Northwest's present agreement to serve the British Crown Colonies with three flights a week through an agreement with Hong Kong Airways Ltd. terminates July 31. Two years ago, President Eisenhower approved a Civil Aeronautics Board recommendation that Northwest be authorized to fly to Hong Kong, but the State Department has not yet obtained authority from the United Kingdom to negotiate this service.

✈ Air Transport Association survey of air traffic control problems reports that increased civilian aircraft in increasing airline route mileage by 20 to 30%, and, in some cases, additional route mileage required to connect with other airlines is as high as 70%. Between New York and Washington, the route mileage is increased by 25% because of aging enroute caused by military reserved airspace.

✈ Watch for an early order for jet transports by Iberia Airlines. Iberia President Dr. Basilio Delgado recently returned to Spain from the U.S. after long discussions with manufacturers on a jet replacement program. Iberia 747 appears to be the latest choice of the Spanish airline.

✈ Egypt has lifted its ban on British Overseas Airways Corp. operations into Egyptian territory. BOAC has not operated into Cairo since Oct. 24 when Israeli invaded Egypt.

✈ American Airlines will release 10 Convair 440s for sale in September. The airline will replace the Convair with its DC-6s while it is converting four or more to standard configuration. First of 11 DC-7s to be delivered early this fall will replace the DC-6s. American now operates 75 Convairs on its short and medium-haul routes.

✈ Continued increasing an increase in the Electra backlog to more than 200 units. Total orders are now 130. Although Boeing development Electra expenses will hold savings down this year, the company expects to reach a new high in commercial transport deliveries during 1957, with sales totaling \$200 million. Because the market for the 344 Convair 440s, the Convair 440 is anticipated, the company is increasing a lot on this model. The 44 440s to be produced during the year are not considered large enough volume to offset development costs involved in the redesigned wing and other changes.

✈ American Modernization Act has been reported out of the House Commerce Committee but not without discussion. Reps. John Moss (D-Cal.) and John Dingell (D-Mich.) charged that three years' delay for the establishment of a permanent Federal Aviation Agency is unnecessary and accused the Commerce Committee of being obstructive to the transfer of control of the Civil Aeronautics Administration. They said Edward Costa, believed for some 15 months to produce what may well be a historic bill of a House of Federal Aviation, but he recommends only the creation of a "lead sheet." The congressman warned that the bill will not permit an aviation system adequate to meet the jet age and added that it does nothing more than create a research and development agency without authority.

✈ New California law provides that various approach areas must be approved by California Aeronautics Commission before a permit for a new airport is granted. Law prohibits the construction of buildings at the installation of an obstruction such as antenna towers and trees within the zone.

✈ Civil Aeronautics Board continues has recommended the summer of August or earlier permits to Companies Mexicanas de Aerolineas and Sociedad Aeromarina Mexicana. The recommendations, if accepted by the Board, would give Mexicana authorization to operate from Mexico City to Chicago and San Antonio. Sociedad Aeromarina would be authorized to operate their route separately from Colombian territory, to New York and Montreal, to Miami and New York and to New Orleans.

8 OUT OF 10 OF ALL THE WORLD'S INTERNATIONAL AIRLINES USE

An unusual opportunity to purchase a pressurized, airconditioned plane for corporate use!



American Airlines announces the sale of 8 Convair Aircraft (Model 240)

The Convair is an ideal plane for corporate needs. It is an outstanding dependable aircraft seating forty passengers in pressurized, airconditioned comfort. These planes have been fully maintained to airline standards. Priced at \$375,000 each, one or two will be available September 1st—the remainder by October 1st. For information and specifications, write: Mr. B. L. Southwick, Manager Aircraft Sales, American Airlines, Inc., Tulsa O & S Depot, Tulsa, Oklahoma.

AMERICAN AIRLINES
America's Airline

DC-30s together, the company reportedly said that it would be disposing of its older surplus transports over the next few years. Shick has seen DC-3s up for sale now, and some of its C-40 fleet will be available in the future.

Since the carrier will be selling and leasing aircraft for its own use, Shick decided to expand the operation and have the aircraft sold a full time business. The division will be headed by Kenneth T. MacKenzie, who has worked for the airline since 1946. MacKenzie previously was with Curtiss Wright, General Motors, Nucor, Pacific Railroad and Wagner Electric. In handling its used transport sales, Shick can either sell aircraft on a commission basis or buy them for resale. The carrier also could decide to lease the aircraft it buys in order to improve their market value.

President for an overhaul operation was set this year when Shick's Burbank facility took a badly damaged Air Force C-119 and converted it to a DC-6 converted transport. The DC-6 has been in service on the Shick system since May 1.

SHORTLINES

► Panagra has completed installation of electronic radar on all of its Douglas DC-48s and DC-7s owned and Air-India service. Panagra installed its first radar on a DC-6B in regular service between Miami and Caracas (Arriva April, 1974).

► Air France flew its first Lockheed 1649 Constellation to be delivered from Burbank, Calif., to Paris on 17 Jan. 11 min. The new aircraft took off from Burbank at 7:16 A.M. (PDT) on Feb. 7 and landed at Orly Airport, Paris, at 9:27 A.M. Paris time, covering the 5,019 statute miles at an average speed of 539 mph.

► Iberia Airline of Spain has begun operating a third weekly fast-class non-stop combination service on its new stop route between New York and Madrid. The flight, which leaves New York on Tuesday, will continue through Oct. 1. Weeklong, twice of two a third flight on Mondays scheduled to continue through September 10.

► Airbus Clearing House reports that airline business between New York and Los Angeles is down 13.47% in May last year. Total interline business transacted was \$61,982,601.08 in comparison with \$70,028,325.09 in May 1973.

► Aerolineas Argentinas has been accused from Argentina Air Ministry control and has been granted the status of a corporation, totally state owned.

COCKPIT VIEWPOINT

By Capt. R. C. Robson



Zero-Zero Landings—II

The all weather experimental lighting display at the Andrews Air Force Base was described last week. Since the installation was temporary, the various fixtures were temporarily placed on top of the runway surface. Because of these tests and nearby observations actual landings were avoided. Generally we maintained a safe altitude of 15 to 20 feet above the pavement until all pilots agreed that if the lights had been flash mounted normal take landings could easily have been made.

Good Testing Conditions

Meteorological reports indicated zero run for all approaches. Cockpits and instrument panel observations taken on each approach varied from a 50 foot ceiling and 400 foot visibility to as high as 1,000 feet ceilings, range visibility. As one standard this is "low weather" and can be deemed a fair chance for testing. (It also indicates some serious discrepancies in our weather reporting methods but that is another story.)

One of the first things evident was that the 90 foot gauge (a row of lights 45 feet on either side of the center of the runway) was inadequate. It required noticeably more "interpretation"—and therefore hesitations—before a pilot would commit himself to a landing. In general it gave the same appearance as a narrow runway with normal edge lights. The 60 foot gauge was by far the best of the lot.

Ungrated ground lights over 200 feet seemed adequate when visibility was better than 700 feet. At the lower limits the 200 foot spacing was sufficient to have gaps and distort the "line of light" effect. Also this was a homogeneous fog condition: not rain or blowing snow, which we have not flown yet and which might obstruct our vision more effectively. At this point it would appear that 100 foot spacing on the 60 foot gauge is the best answer.

The Sylvania edge floodlighting provided a marginally good amount of light on the runway surface with little glare. The outline of the runway was clearly delineated. On one occasion (one dashed by several other pilots) it was that the floods did not provide enough depth perception—not enough indication of ground plane. There was no focal point which I could "lock on to" for landing. Sylvania is now working on an improved light plus contrast solution which may help this problem.

May Need 3,000 Ft.

Narrow gauge lights at Andrews extended for about 2,200 feet down the runway. They seemed adequate for the conditions we had. But remember we have not flown it in rain or snow or with heavier, later aircraft which may need more leeway. For our major terminals it may be that a full 3,000 feet will be needed to cover all weather conditions. Smaller fields and smaller aircraft with higher losses may find 2,000 feet outside.

There is also the very real problem of what to do with the airplane after it is on the ground. From personal experience I can assure that it is a hell of a thing to land and then have to be towed to the terminal. There must be some visual guidance which will allow the pilot to find the high speed turn off and steer safely off the runway. At this point we are experimenting with a single row of centerline lights commencing where the runway gauge leaves off, and wondering if these can serve into the taxi area with no further guidance.

Many runways will be extended a thousand feet or so to accommodate our coming jets. Serious considerations should be given to installing flash lighting in these, and new, runways. I guarantee that narrow gauge lighting will enhance our on schedule operations. Next I will discuss early construction and road training aids.

Large or Small, General Electric Gas Turbine Engines Deliver More Power Per Pound, Give America's Aircraft Greater Mission Capability

The low specific weight of the General Electric J79 and T58 gas turbine engines, when translated into smaller, lighter airframes, helps increase aircraft range and payload. Benefits like these stem from the advanced, high-power, light-weight designs common to both the T58 and the J79. Each delivers more power per pound than any other comparable engine in its class.

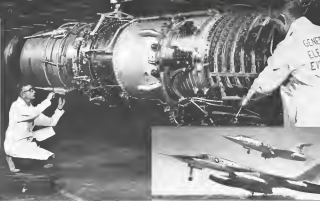
The J79 and T58 join more than 31,000 General Electric J47 and J75 engines now flying 5,500,000 miles daily from bases around the world. Both have evolved from a family of aircraft gas turbine engines dating back to the nation's first jet engine, the G-E I-A (1942). Teamed with the products of ever advancing airframe technology these two General Electric engines are now making possible aircraft of unsurpassed operational effectiveness.

General Electric Co., Schenectady 5, N. Y.

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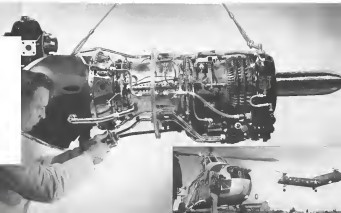
J79

Better than the famous G-E J47—yet twice as powerful—the General Electric J79 has the best thrust to weight ratio of any United States production jet engine of comparable size. The J79 is a major factor contributing to the outstanding performance of the U. S. Air Force's Lockheed F-104A interceptor and Convair F-106 bomber at both sub- and supersonic speeds.



T58

Proud to power the most powerful turboshaft engine yet conceived, the T58 is now undergoing flight tests in a Sikorsky SH-34 helicopter. It is also scheduled for use in the Vahid W-11 light cargo and Kaman HH-43A utility helicopters. The 315 pound T58 develops 1804 Military SHP and has an SFC of 8.69 under continuous cruise rating of 875 SHP—exceptional power and efficiency for helicopters.





PLAINVIEW photograph of Canadian CP-307 Argus in flight indicates flexibility of wings and tail to forward fuselage, from which it was derived. Flank extension on top of the fuselage at wing area among the 40 mounted on the airplane. Tail extension is for MAD gear.

Test Program for CL-28 Moves Ahead

Montreal-based Canadian CL-28 long range reconnaissance airplane for the Royal Canadian Air Force has made its first flight and the third airplane has rolled out the door, making for a production schedule of one a month.

The first airplane, which flew last spring, has completed more than 42 hr of the 67 hr of its Phase I flight test program. Phase II program will include basic tests of all components—electrical system, fuel flow system, etc.—and will pave the way for delivery of the third aircraft to the RCAF only this fall after the usual routine flight test to establish its airworthiness.

Although the first airplane, pictured a relatively close look at these flight photographs, it is serving as a pattern pg for all the changes requested by the

military and is beginning to acquire the same sort of "Canadian" character that the PW, which it is designed to supplement with the RCAF, developed after service use by the U.S. Navy.

First test airplanes will be retained by Canadian for further testing.

Transport Version

RCAF also has ordered a transport version of the airplane, which will be powered by Bristol Orion turboprop engines instead of the Curtiss-Wright K1750 Turbo-compound engines of the CL-28. Transport is designated CL-44, pending a change of a name and number by the RCAF (AW, April 27, p. 28). RCAF designates the reconnaissance airplane the CP-307 Argus.

Canadian also is offering other the military or civil version for sale, but

reports no firm orders for either. Campaign is being conducted in concert with Bristol Aeroplane Co., from whose Britannia design the CL-28 was derived.

Describing the engineering of the airplane at a recent meeting of the Engineering Institute of Canada in Brock, W. E. Elbel, vice president engineering, and Everett B. Schoelen, assistant chief engineer, said that the fuselage redesign amounted to about 55% of that required for an original design. Wings and tail are largely the same, but installation of the piston engine necessitated 100% new design forward of the firewall.

Much of the redesign was needed to convert materials, parts and equipment to American standards. One case was the hydraulics, which in the Britannia are designed around a 4,000 psi pres-

sure supply. At such, it is strictly satisfactory, the Canadian engineers said. Practically all controls operated by the RCAF have 3,000 psi systems, and steel supplies of pumps, gauges or ducts, accumulators, fittings and lines are available in supply depots. For reliability, and based on experience, the hydraulic system on the CL-28 was re-designed to a 3,000 psi base, the capacity adjusted to a somewhat greater demand because of the addition of its dual-hydraulic operated equipment, it took its share.

Secondary Ejection

Furthermore, a pneumatic power system not available in the Britannia, was designed and developed and will use the dual-hydraulic system. Canadian said that is the first time such stores have been power erected.

Approximately 15,000 engineering drawings were required for 75,000 detail aircraft parts. Of these, 8,000 were Bristol drawings with Americanized processing. The other 10,000 represented the bulk of the engineering design effort. Since it began in April 1954, the engineering effort expended was equal to 1,800 man-years, and peak manpower total was 550.

Electrical power supply was a major problem since the airplane carries about 4,000 lb of avionic and communication equipment requiring 40 antennas.

Among them is a detector array in



ARGUS in profile depicts thin fuselage and redesigned wing. Reduces its cross (below) to path accommodate nose gear.





One simplified Tool Design fits every **TORQ-SET** size, style and head configuration

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- 2. Simplicity** — forged in a single, one-piece unit.
- 3. Quality** — comes to finished dimensions for instant accuracy.
- 4. Availability** — mass-produced for immediate availability in any quantity.
- 5. Economy** — relatively low cost because of design simplicity and mass production.

What's more, you can get Torq-set in a wide variety of materials — Titanium alloys, Inconel X, Corrosion Hi-Tal, Greek Anodized and many other stainless alloys, including A-286, 17-4 PH, Types 304, 301, 302 and 432.

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THREE PRELAYS are no trouble here in Corvair. Fastage moves back-and-forth vertical fit, because of its height, installed but at vertex of plant where leg is high enough to accommodate it. Part of factory will show that had to be cut out to permit Argus to roll out.

the vertical fit in which a Fibreglas section near the top is lifted in a full lead curving structure. C. A. Brown of Corvair, in describing the Argus structural test program at the annual general meeting at the Convair Aircraft Division, said the static test program of which the insert is a part will continue through next month.

First phase of testing of the insert consisted of tension and bending static tests, loads being applied to the fin top either above or below the insert by cables, pulleys and dead weights. The Fibreglas panels "flown and tested a little more flexible than the aluminum alloy construction.

The large size window for each side gear was a tender situation. It was tested by application of rubber water bags to the Fibreglas honeycomb surface with pressure vessel to produce correct distortion.

Redundant Test

Little permanent set occurred under ultimate conditions, and in another test, 100% of ultimate strength had been reached before the redunc test area at the connections along one side and the front.

Major structural change in the fastage was the inclusion of the back bay in the Argus's longitudinal shear. The wing's length has increased and wing box frames perform the same function in bracing above and below the wing in the structural pattern in bracing



frames from the wing surfaces directly here and aft of the wing box, and box frames bolted to the wing spar perform in transferring them to the fuselage shell.

Because of reduced distance between horizontal members in the Argus, the shear tend to peak up and heavier design around the wing box were needed.

New section was revised completely in the Argus and fastage outside were altered for the military requirements. As a result of the revision, and because the Argus is unpowered and the critical design stress and bending was almost fully appreciable, most of the skin stringer pins were redesigned.

Static tests generally passed the

Sperry B-58 Control

Convair B-58 Hunter's primary navigation and precision attack will be provided by Sperry Gyroscope Co. under a follow-on contract. The various inert B-58's flight path through space to its target, the control system of plane's "thermo-cool" pod at a precise point in space.

According to joint USAF and Convair commitment, the equipment, presently undergoing test bed flights at C-151, C-190 and B-58 aircraft, is low losses at altitude, requires 1700 lbs. less space and weighs 3500 lbs. less than present operational systems.

Some of the design, although changes had to be made in a few areas in a simulated side gear on the vertical tail, the least load was carried successfully without permanent set. However, the main flange of the rear bulkhead added both and will need stiffening.

Metal bending, a process unfamiliar to Convair, was recommended by the Bruteaux design. Right side wing joint, representative of various sections of the aircraft, were tested at various joint locations—two banded not cracked. There was little to choose between banded and pointed sections as far as fatigue life is concerned, Bruteaux said.

Perk Fittings

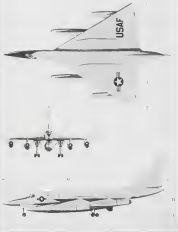
Tail fittings arranged in the neck links, fitting at approximately half a million cycles. Though adequate for the Augus, a development program is being carried out.

Further tests are scheduled for a fuselage and tail specimens and in the fifth phase of the program it will be tested in destruction. It, as expected, the fuselage broke off at the wing box, ditching tests will be simulated by means of pressure bags, the imitating the soft and final phase of the program.

RCAN requirements (AW Feb 11, p. 26) demand operation of the aircraft under all climatic conditions to loss of -65°F. Since the power systems provide an source of warm blood at 40 to 45 the Bruteaux turbine engine, four internal combustion heaters with a total capacity of 2,300,000 Btu were installed. They draw fuel from the aircraft fuel supply.

RCAN specialist groups will join in the testing program. It will run for about two years and will be carried out on the first five to seven aircraft.

A major phase of the ground test program has been installation of the electrical equipment on a simulated fuselage to determine whether there was any interference from any of the electrical gear.



SHADED AREAS in the sketch indicate the location of sandwich type structural panels used for the B-58 skin. Sandwich (dashed) is formed by bonding aluminum or steel outer panels to the honeycomb filler. That in the drawing at right is formed by forming stainless steel sheets in a metal honeycomb core. The bonded panels are exposed to engine and exhaust heat as well as aerodynamic heating.



B-58 Makes Extensive Use of Honeycomb

Convair B-58 Hunter, dimensions of which are shown in three-view (left), carries various types of detachable pods. The one shown (right) does not emphasize one, which is 34% longer than an F-5H. The remote pods available for use on the Hunter are each tailored for a specific mission. Their shells contain a considerable amount of fuel as well as a weapon. Second configurations of stabilizing and lifting surfaces have been tried on the pods indicating that the problem of steering and dropping such devices is not easily solved. Lower photo shows one rocket configuration leading with drag chute extended. The USAF bomber was modeled at Convair's Ft. Worth, Tex., plant (AW July 15, p. 26).



SPECIFICATIONS

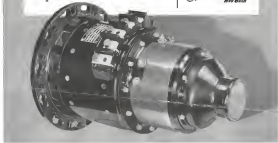
Red Bank Division, Bendix Corporation, 1500 North 10th Street, Allentown, PA 18109

Form No.	Vol- tage	Cur- rent	Rated Speed	Rated Power	Rated Torque	Rated Efficiency	Rated Life	Rated Temp.	Rated Altitude	Rated Pressure	Rated Vibration	Rated Shock	Rated Humidity	Rated Salt Cryst.	Rated Magnetic	Rated Electrostatic	Rated Radio Interf.	Rated Acoustic	Rated Optical	Rated Infrared	Rated Ultraviolet	Rated X-Ray	Rated Gamma	Rated Neutron	Rated Cosmic	Rated Other	Rated Total	Rated Remarks
1000-1	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-2	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-3	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-4	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-5	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-6	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-7	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-8	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-9	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-10	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-11	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1000-12	20	4	11	4.05	1000-1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

*These generators are designed for operation at sea level with an ambient temperature of 40°C.

*This generator is designed for operation at sea level with an ambient temperature of 40°C.

*All generators are built to MIL-STD-883C and MIL-STD-883D which require testing at 100°C at sea level, 40°C at 10,000 ft, and -40°C at 40,000 ft, and will be built to meet these requirements.



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If you have an AC Generator cooling problem, here's the solution. Bendix Red Bank High-Temperature AC Generators meet military class C air-cooled specifications and combine a maximum of size and weight with a maximum of performance. Ranging from 9 KVA to 60 KVA, they are designed as part of complete Red Bank high-temperature AC generating systems. These also include magnet amplifier, voltage regulator and system protection components. For details, write Red Bank Division, Bendix

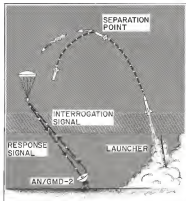
Aircraft Corporation, Allentown, New Jersey.

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Red Bank Division



ROCKETSONDE system is proposed means of getting weather data at 70,000-150,000 ft.

Low-Cost Rocket Vehicle Urged For High-Altitude Weather Data

Reliable meteorological data at altitudes between 70,000 and 150,000 ft., above the ceiling of routine balloon-borne observations, can be obtained by U. S. Weather Bureau using low-cost rocketborne sensors, according to a study by Stanford Research Institute, Menlo Park, Calif., indicates.

Study was made for Federal Civil Defense Administration, which needs such information on frequent and accurate basis for predicting storm, fallout patterns and contaminated cloud formation.

Study showed several characteristics of rocketborne should include:

- Systems which can be operated in a variety of weather Bureau proposed without extensive training program.
- High order reliability in data acquisition and operation of system as a whole.
- Low overall developmental costs, taking as many previously known influences as possible.
- Propulsion units inexpensive enough that annual budgetary provisions need not be made to insure adequate supply for high consumption sites.

SRI recommendations for the system are:

- A single-stage solid propellant rocket to carry a payload of 150,000 lb. which would be released.
- Tracking and telemetry system, optical data by AN/GMD-2 rocketborne system being developed by Aerojet Corp., with modification of ground equipment for better tracking and ranging, plus development of a single, dual-frequency band radio system.
- Development of a parachute, probably a guide-parachute type, which would open automatically at 150,000 ft. The parachute also would act as a wind profile in descent.
- Development of a thermalizer with a properly added reflective coating which could function as a backup in a hazardous case at the altitude of interest. Since present sensing elements are inadequate, pressure and humidity readings would not be taken by the vehicle in steps with, but development of a laserimeter for pressure sensing.



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Today not only can you rely on ERGO to design and build the same high quality equipment as it has in the past, but you can expect its increasing range of new products which will be made possible by the joint skills of Nuclear Products and ERGO's engineering and production teams. Flight Simulators, Nuclear Research and Power Reactors, Aircraft Support Systems and Equipment, Nuclear Products for Defense and Peace, Electronic Communications, Spacecraft Technology for Automated Production.

This is a new dimension in control engineering and manufacturing available to you through Nuclear Products.



For overall inclusion should be worth the effort.

• Development of a model vehicle capable of mass production for approximately \$100.

Calculated quantities of the rocket measured by SRI indicate it would be about 4 to 5 in. in diameter, 6 to 8 ft long and have an impulse of 5,000 to 10,000 lb-sec.

It would carry a payload weighing approximately 12 lb., including nose cone and ejection mechanism, to 100,000 ft with maximum acceleration held to 25 to 30G.

While SRI pointed out that eventually the most desirable system would include a rocket motor case which could be impregnated, burned or pulverized to eliminate public hazard, the study recommended a present alternative of a network of private stations which, while in areas where danger is minimized, could provide adequate coverage of continental U.S. Network stations all



CF-105 Main Landing Gear

Main landing gear for Aero's delta wing supersonic interceptor, the CF-105, features a single-wheel, tandem axle to permit storage in a very thin wing box. The relatively long main landing gear is required by the delta wing configuration of the aircraft. In order to store it within the space available, the gear has to be shortened by its retraction by a special linkage. Design of the wing structure made it necessary to provide a clear way for the pivot shaft which has been mounted on the Landing gear strut during retraction. The undercarriage is made of ultra high tensile steel with a strength level of 260,000 psi.

AVIATION WEEK, July 27, 1957

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DETREX, pioneer in all phases of metal cleaning and processing, uses its experience and facilities to bring increased efficiency to any degreasing, washing or coating operation. Write today for detailed information on the wide range of DETREX methods, materials and services. There is a perfect combination to meet your requirements.

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SMALLEST VERSION of the automatic direction finder used in most planes (30,000/000 hours of flying time) than its competitive units combined. LEAR ADF-100 is noted as operating, lighter in weight, by far the lowest priced.

Can furnish power and excitation for a LEAR KT-10 VHF transmitter.



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LEAR ADF-100

THE WORLD'S SMALLEST ADVANCED ADF is the only fully-transistorized navigation system. LEAR ADF-100 is the lightest, most compact all-time-circuit direction finder, was only one-tenth the power other ADF's require.



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THE PRIVATE FLYER'S ONLY full-featured three-axis light-control system. LEAR L-5 Autopilot offers extensive ILS and automatic altitude control. The only dash-only system's automatic pilot for all light and medium planes.

MAY EQUAL THESE INSTRUMENTS...



LEAR LTR-500

FIRST AND ONLY 500-channel VHF transmitter. LEAR LTR-500 weighs only 36 pounds, occupies only a 1/4 ATR package, costs no more than any offering a fraction as many frequencies. Provision for VOR, VAK, and ILS receiver. Your airplane will be cleaner before than well.



LEAR LVT-30

THE INDUSTRY'S STANDARD receiver for medium size business aircraft. LEAR LVT-30 includes automatic channel selection. Clear, sharp instrument with reception on 36 channels.



LEAR L-5 AUTOPILOT

BY FAR THE LIGHTEST AUTOPILOT system has latest high performance aircraft (weighs 80 to 90 pounds less than others). LEAR L-5 Autopilot System also meets, yet includes (all automatic) trim, safety cut-out, altitude control, ILS.



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THE ONLY EMERGENCY INDICATOR with built-in on-on converter, fully-transistorized. LEAR VORTAN adapts to any VOR receiver covering main frequencies. Just tune to the desired station, select the course indicator, and fly the needed.

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HEADING, RATE ANGLE, AND OTHER all presented naturally on a single dial. LEAR NAFLI (NAutual FLight Instruments) system offers magnetic heading and latitude compensation, virtually combining the LC-1 Compass with the most sensitive attitude indicator made.



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LEARNER SERIES of the light-weight receiver/indicator and excitation package which has become practically standard equipment on light aircraft. LEAR LTR-100 system includes VHF receiver with "Tone Tuning" and Dual Meter 8, L2 receiver, 11-channel VHF transmitter, marker beacon receiver.



LEAR LTR-100

LEIGHTEST GEAR LOW RECEPTION in the market (five pounds). LEAR L-20-1 features built-in transistorized high-voltage power supply, has full 20-channel coverage, gives real power for magnetic ILS system and dual ILS indicators, fits a short 1/4 ATR package, meets AFINC requirements.



LEAR L-20-1

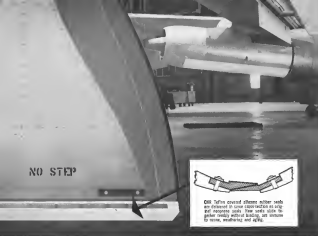
POWER ON/OFF-TRANSISTORIZED latitude-compensating compass available. LEAR LC-1 is reliable and accurate even at high latitudes and magnetic storms. Navy's choice (designated Type MA-1) over all other directional systems.



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CHR adapts new seal development to B-47 bomb bay doors.

Teflon covered silicone rubber seals developed by CHR are replacing original neoprene seals. Here's why . . .

Extreme low temperature operating conditions played havoc with the neoprene rubber seals originally designed for B-47 bomb bay doors. Shortened by aging and cold, many of the seals split and ripped off when doors were opened and shut in flight.

CHR Teflon covered silicone rubber seals solve these serious life problems. Silicone rubber is immune to ozone, weathering and aging. The smooth Teflon-treated Teflon surface permits seals to slide readily without cracking or binding. The seals have -100°F to 500°F flexibility. They self-seal and also shed water, ice and dirt. The silicon ester provides im-

proved protection against oxidation from engine vapors.

CHR Teflon covered seals are also being used on other planes where low friction, sliding action, aluminum resistance and resistance to fuels and synthetic lubricants is required.

Our experience in jetting equipment with all types of surfaces and engine seals suffering all forms of silicone rubber reinforced with fabric, Teflon and metals can be put to work for you. We select your equipment for specific applications. Call or write. CHR field representatives are available for direct contact.



CHR Teflon covered seals are now being produced in large sizes and being used all types of aircraft rubber seals, doors and joints (clockwise).

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are presently eating and opening USWB facilities.

SRI estimates total cost of development, which could be spread over a two- or three-year period and includes the 50 nuclear qualification flights required by military agencies at approximately \$420,000.

Estimated cost of expendable units, including instrumentation, parachute and cockpit, was set at \$115 each if production rate approximated \$100,000 per unit.

Laboratory to Study Astronautics Fields

Anas, Calif.—Ameset General Corp. has established astronautics research laboratory to conduct studies in general areas of propulsion, interplanetary chemistry, and materials.

Laboratory has three sections:

- **Propulsion section** will investigate starjet, space, chemical, and gas, gamma ray, solid, and nuclear plasma propulsion systems.
- **Interplanetary section** will conduct research in interplanetary dust, plasma, and chemistry of extraterrestrial matter, interstellar of space vehicles with cosmic rays, and temperature sections.
- **Materials section** will engage in studies to develop high and low temperature materials for extraterrestrial propulsion systems and vehicles.

Wing Formed to Train IRBM-ICBM Crews

Formation of the 704th Strategic Missile Wing at Cooke AFB, Longport, Calif., to organize and plan ballistic missile crew training has been announced by Maj Gen. B. A. Schmitt, chief of the Air Force Strategic Missile Division at AFHQ.

The 704th has assumed command of the 91st Air Force Group which is the headquarters unit at the base. Col. William S. Rader will command the 704th.

CAA Convair 440 Equipped for Tests

A Research Aviation Service Co., Los Angeles, is installing a GTP-18 gas turbine in a CAA Convair 440 as and any electrical power unit. CAA plans to flight check under marginal and conventional conditions with the jet plant throughout the U.S. at altitudes between 10,000 and 20,000 ft.

Research also is installing a two-stage turbojet in the plane. One type-plane is pilot's center panel, which at electronic operation station is cabin.



Gassing Up At 530 M.P.H.

This Flying Pipe refueling system, developed by Thieblot Aircraft Company, vastly extends the range of jet planes, especially fighters.

This Thieblot device is a packaged unit consisting a "Flying pipe" to enable fighters to refuel in altitudes above 30,000 feet and at speeds over 530 miles per hour. It should soon make fighter-to-fighter refueling commonplace. Formerly only slower planes could be used as tankers.

The Flying Pipe is one of the outstanding new Thieblot projects, developed over the past two years under contract to the Aircraft Laboratory of Wright Air Development Center.

The Flying Pipe is a prime example of the special abilities of Thieblot Aircraft Company in designing and producing aircraft components and ordnance.

Other Thieblot contributions include a ballistics data aircraft nose for cross-wind firing, purge rail systems for jet trainers, a boundary layer control system, a nose-wheel steering mechanism, an escape rail for ditched aircraft, and other equipment of advanced technology.

For both government and industry Thieblot is making tomorrow's aircraft technology available today.

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time lapse trigger for outer space?

40 billion to 1 ratio
gear reduction ratio . . .
designed by ELGIN

No longer than your thumb, this gear train is ready . . . and working. Its use is simplified, but what would you use it for? Here is an off-the-shelf compensation you might consider at \$3,000 BPPM (based on one revolution/24 hours). And, as an added advantage, its efficiency is amazingly high.

Elgin's constant search for new ideas and concepts has built a production and research organization extending from Elgin, Illinois to Lancaster, Nebraska to Corona Park, California. The development of a 30 billion to one ratio gear train is a stark example of Elgin's ability to create tomorrow's products today. It can do the same for you in the field of time-measuring instruments, timing, safety and timing devices, and small precision gearing, error trains and distributors.

Elgin's rapidly expanding technical staff now offers a broad range of opportunities for qualified engineers and technicians.

First Sabre VIs Ready for Germans

Last batch of T-15 Sabre VI jet fighters for West German Air Force command first flight tests at Canadian DND Flight in Montreal. The aircraft have been officially accepted by the Luftwaffe, and are being prepared for shipment.

Certificates of Necessity

Washington—Office of Defense Mobilization has received Russo-Wend Bridge Corp., Los Angeles, certificate of necessity for acquisition for aircraft when in the amount of \$13,415,577 for research and development. Of the amount \$677 was official. Other certificates included:

Paula Williams Special Defense Label Aircraft Corp., Los Angeles, Calif., \$1,000,000 for a Sabre VI jet fighter.

Scientific Corp. of America, Los Angeles, Calif., \$1,000,000 for a Sabre VI jet fighter.

North American Aviation, Inc., Torrance, Calif., \$1,000,000 for a Sabre VI jet fighter.

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“Engineers—here’s how we’re taking part in the electronics revolution toward solid state devices”

R. B. HURLEY, holder of degrees from the University of California and University of Southern California, in a Design Specialist in Control Systems. He is a nationally recognized leader in the field of electronics.

"Here at CONVAIR research we are constantly studying ways to apply the new miniature solid state electronic devices: the diode, rectifier and transistor. So new to this semiconductor industry, and so vital to our future — both for the military and industry — that our teams of electronics engineers actually 'go to school' under most of the foremost experts in the field.

"As the first fully integrated master plan in the U.S., CONVAIR research designs and builds the Navy's major aerospace missile. And, realizing the potential value of solid state devices in meeting the critical requirements of such aerospace missiles, we initiated a 'transistor program' early in 1959. This program has multiplied many times to become one of the most important in the industry.

"You, as an engineer, can appreciate the tremendous expansion that will come in the application of solid state

electronic devices in the next few years. And you can readily understand the advantages of studying and working with these devices, guided by the advanced thinking you will find at CONVAIR research.

"You'll like the atmosphere here, where you see and feel accomplishment. And you will enjoy living in Southern California's beautiful Pomona valley. For greater career opportunity — for your future's sake — used for more information about CONVAIR research today! Write to: Engineering Personnel, Dept. 3-E."

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MALFUNCTION and Capacity Trainer (MAGT) 5001, is a radio-controlled, electromechanical device built to a MIL-STD-883C, Class-B, Shock-Tested System configuration. Purpose is to teach a line mechanic to know MAJNA data flow. Wrong is shown at right.

Report on QPRI, Part II

USAF Probes Systems Maintenance

Lowry AFB, Colo.—Probing into the factors of human skills and performance—determining how to maintain a well-maintained aircraft is, naturally, essential to maintenance in one instance —is one of many USAF personnel problems being studied by the Maintenance Laboratory at the Air Force Personnel and Training Research Center here.

Laboratory Mission

The Laboratory's mission rests on three basic programs:

- **Technical program** of research into factors, methods and procedures for training, evaluating and utilizing Air Force maintenance personnel—such as introducing manipulators in the flight line.
- **Operational program** for the development of Quantitative Personnel Requirements Information (QPRI) on maintenance and servicing of weapons and supporting systems. Under this program the laboratory has, as a preliminary, QPRI reports on 30 different weapon systems. Studies have been completed, 14 are in progress.

The 30 weapon systems, and the four categories into which they fall, are:

- **Missiles**—QPRI has been completed on GAM-67 Condor, GAM-1 Pelican, SM-70 Tyke, IM-99 Bomarc, QPRI is in progress on GAM-67 Raven, SM-62 Hawk, SM-60 Navaho, SM-67 Altus.
- **ICBM** SM-68 Titan ICBM, WS-815A Titan II, SM-61 Minuteman.

• **Fighters**—QPRI completed on F-4H, F-5H, F-1H, F-104A, F-105, F-106, F-37H in process on F-106.

• **Bombers/Cargo**—QPRI completed on B-52, B-54, C-119, KC-135.

• **Special**—QPRI completed on Crash Landing Vehicle (QPRI in process on WS-232A, auxiliary ground launcher, ground based electronic countermeasures, ballistic missile defenses and support system, intelligence data handling, SAGE, TRACALS (traffic control net leading system).

Technical Areas

The five technical areas of maintenance and servicing training in which the Maintenance Laboratory is engaged are:

- **Conditions of efficient learning.** It determines conditions of environment and types of personalities of personnel which produce the optimum learning and retention upon persons for maintenance personnel.
- **Characteristics of maintenance training equipment.** Laboratory defines the characteristics of new maintenance training equipment.
- **Maintenance of individual personnel.** The facility attempts to assess the performance and knowledge of mechanics on the job in each USAF command as Strategic Air Command and Tactical Air Command.
- **Asks to job performance.** Laboratory determines what aids are effective to improve job performance and finds those aids into a weapon system's development cycle. Examples are guidelines, techniques for control, handbooks which the Laboratory is planning for ballistics missile systems. The books describe various missile components show how the mechanic should keep them in correct operating order. The books are small enough for the man to

take along with him to the job for self reference.

- **Forecasting maintenance job requirements.** How do you derive a job description that is realistic, understandable and means the same thing to every body? Another facet of this problem is to predict what maintenance job requirements will be in years to come. Typical example of this type of forecasting is the Laboratory's work on how to maintain WS121A—the first precision bomber—with remote control manipulators.

Maintenance by Manipulator

An active program is exploring the worldwide problem of how to train men a maintenance aircraft with manipulators so that the mechanics can be adequately shielded from radiation.

A laboratory technician told Aviation Week that manipulators have been produced and a research program is being established. Atomic Energy Commission's extensive backlog of experience with manipulators is of little use to USAF because the AEC uses the device mainly to lift and move objects from one place to another while the Air Force wants to use them to serve all manner parts—a totally different set of actions.

Use of manipulators requires special motor skills on the part of maintenance personnel, then, and a set of standards for handling parts assembly in respect to depth perception. To solve this problem, technicians are working with three-dimensional color television.

Some of the problems which the laboratory will handle include:

- **What will be the probable effects on the time it takes to maintain a weapon possessed place of the work in done by manipulators?**
- **What handicaps can be expected of light, trained personnel in the performance of maintenance functions with manipulators?**
- **What new skills will be required at maintenance personnel?**
- **How much training will be needed for maintenance mechanics to reach peak performance?**

Psychology in Air Force Academy

Starting with the simplest end, the Air Force Academy has begun a course in general psychology. The course will be provided. It will be taught in the same manner as it is given in the best colleges but will have an Air Force orientation with a set of relevant subject matter. The course will be taught in common by members of the Air Force Personnel and Training Research Center's Maintenance Laboratory at Lowry.



MASTER-SLAVE manipulator being tested in an experimental system by AFFTC Maintenance Lab to determine its adaptability to WS232A missile-powered bomber.

First step will be to find out the limitations of the mechanics and determine how to train men to work them.

Minimize Practice

Large number of weapon systems—such as environmental ballistics and other pose severe operational and maintenance problems because there is no precedent as to which to have operational and maintenance procedures.

In a laboratory setting, just as it is, that is would be weapons, start learning weapons by practicing on radios or on an attempt to learn how to handle new missiles is practicing on older weapon systems. To do this, no article on the old "buddy" system which will be used on the new weapon systems to gain as much experience as possible in how to handle them.

The five elements of a training device which should be built into the new are:

- **Guidance.** Students should be guided to the right response to a question or problem.
- **Feedback.** A man should be shown whether he is proceeding correctly or incorrectly on his maintenance procedure. If he is right, the device should show him a right if he is wrong, it should tell him in and indicate what is right.

• **Practice.** Training should give a man as opportunities to practice a given procedure whenever possible.

• **Priming.** The device should allow a student to pace his training to his own skills and attitudes. When multiple procedures are involved, practice should be repeated and the student allowed to proceed on his own.

• **Evaluation.** The trainer should evaluate a man's progress to show the student how he is doing and to give the instructor a yardstick to measure his progress. Ideally, evaluation should be accomplished automatically and on a permanent record for future use.

Among trainers developed by the laboratory are:

- **Subject Matter Trainer.** The device is used to teach facts, both practical and psychological. If the student is to be given new questions, it gives him guidance to the correct answer. It he would have certain knowledge, it tests his knowledge. It is self-instructional, allowing a student to learn new skills on his own, releasing valuable in classroom to teach more complex skills. It also allows students to proceed at their own pace.
- **Practical Trainer.** This device is more practical than psychological. It requires an instructor to work with the student. Advantages of this type of trainer so that it does not use actual

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QMS-developed hooker helps mechanic install light on Ford Silver Light

modern electronic systems, they cost 1/10th of 1% of the total electronic system they test and they are highly reliable.

Examples of such devices developed by the Maintenance Laboratory are the R-4 fire control system troubleshooting trainer and the KC-130 engine breakdown system troubleshooting trainer.

Other types of training devices which are in growing use in the aviation industry are:

Part two or task trainers, made by such companies as Barton Rodgers Technical Training Devices, General Corporation and Stanley Aviation. Also the computerized electronic simulators manufactured by Lock Aviation, Curtis-Wright, Rice and others.

Laboratory technicians are trying to determine how much training a training device should cover to achieve maximum training effectiveness with a minimum number of trainers. Do these methods work? Have one trainer for each task, or have one simulator which would incorporate all tasks in one machine?

Job Descriptions

Dr. Robert M. Gagne, Maintenance Laboratory's technical director, told AVIATION WEEK that one of the knottiest problems facing his organization is, "How does one describe a job as such a way that the descriptions are as predictable between users?"

For example, Does the simple instruction, "Adjust cylinder," mean the same thing in one instance as it does in another? Does it require the same technique behavior on both systems? If not, "adjust cylinder" is not reliable. But then what?

Another aspect of the problem is the instruction, "Set as wind drill." One user might think a single knob adjustment to a specific indicator to

complex calculations to do the job.

The laboratory is not helped much by traditional job analysis terms or techniques—they suffer from the same defect of expectation of intent to describe jobs.

Gagne believes that solution to the problem lies in two approaches: reliability of intent and defining job responsibilities and establishing training requirements.

Task Description

He says that, "in terms of reliability, we have arrived at a level of description of tasks within jobs which is reliable. To achieve reliability, the description must:

- Use action words
- Use words indicating objectives of the task.
- State what the specific equipment is
- State what task equipment is used in

"These four elements constitute a job description which is reliable but which does not accomplish the second part of the problem."

Defining job responsibilities is important. Some kind of job categorization is essential to determine if certain jobs resemble each other—have a more or less common denominator so that common training can be given. This is true, in changes and repair tasks completely, training a man for a new task.

Initially, a new job is usually a blending of known tasks rather than being one for which there is no known precedent.

Also, "new jobs" are more likely to occur in the operation of equipment rather than in maintenance and checkout.

Laboratory technicians are trying to develop a set of scientifically acceptable definitions of behavior needed in Air Force maintenance tasks since these contribute immensely about job descriptions.

A perfect Gagne pointed out is the "Global Definition" which leads to overall a job responsibility such as: A helicopter mechanic needs to know the theory of flight.

Engine Maintenance

Dr. Lucie J. Briggs, chief, Training Standards Section, Performance Branch, replaced the new MIG-10T Avco/Radio Proton Control System (AWCS) Radio Proton Trainer being built for the Air Force and in selecting one light that model.

Gagne calls for delivery of the prototype trainer by the end of November. MIG-10T is the trainer for the MIG-16 AWCS group with 1-102/6. The trainer is made of two major components, a radio troubleshooting trainer and a computer troubleshooting device.

These types of specialists will be trained in the next. A data flow specialist, who will have a general knowledge of both the radar and computer portions of the machine, a radar specialist, who knows the radar system intimately, and a computer specialist, concerned exclusively with the computer system.

Each squadron of F-102A will include one or more of each type of specialist.

Defining reliability which became apparent during the design stages of the trainer for the highly complex MIG-16 AWCS, is that certain instructions would increase the AWCS's maintainability and could be incorporated in its design with little concern in weight or complexity and with no sacrifice in its operational effectiveness.

Learn to the AWCS's maintainability could be achieved on three levels: maintenance easier and more effective, and give the mechanic some prompting on the job that he had before.

Four are details:

- Easier maintenance is achieved by longer lead points to the system's elaborate wiring system out to the main which are placed near the point of the actual system of having them in accessible spots on the bench of the plane.
- Automation of maintenance is increased by incorporating available

systems to that a toolholder can remove and replace a defective component without having to know how it works or even what it is.

• Reliability of maintenance is increased by building more simply into the system to save a mechanic that he has made an error and keep him from providing until it has been corrected. It indicates against a mechanic thinking the system is operating correctly when it is not.

Briggs says, "Recently, in trying to design a better trainer, engineers saw, by such experience, for a new design design which would make the training experience more sustainable. This philosophy has not been reported and should benefit the maintenance of an AWCS whose complexity is so great that it tends to inhibit against the system. Any increase in maintainability would be as welcome to the pilot as to the user. Good low advantage of this new concept is that it can be made at the existing cost of the AWCS, then requiring very little to be added to the system."

Tighter Training

Dr. George B. Simon, chief, Training Equipment Section, Systems Branch, stated that the basic objective of his section is to "make training more efficient, effective and economical through systematic planning to determine the objectives of a training device."



Eisenhower Aights From Helicopter

President Eisenhower is pictured leaving his new B-57 helicopter after it landed in President's recent command headquarters in Operation Alert. The B-57 arrived from White House grounds to the secret spot as part of the 10th House drill on July 12.

was, or of a series of isolated "training doses."

A major problem facing Soviet's group is how much automation should be built into ground check-out equipment for future guided missiles?

If too much is automated, the check-out system can become too expensive to develop and too complex to maintain.

If it is not automated enough, check-out of the system may require too much manpower, individuals may need too much training and the human element may be taxed beyond its capacity to perform.

Therefore, the question is trying to determine that delicate point where automation and manpower are blended to an optimum degree to produce a ground checkout system of maximum efficiency and reliability.

The Air Force is concerned with efficiency, fatigue and morale of its personnel who are asked to perform dull jobs over long periods of time.

very rapid exhaust and correctly to its start.

This situation is exemplified by operators at missile stations who spend long periods of time, keeping a 24-hour fire station alert but whose duties are to monitor a number of dials and gauges. The situation is often aggravated because the man can be isolated in some remote spot, away from friends and friends. Such conditions can create acute problems of morale, and to keep such crews operating at top efficiency and reliability as a 24-hour basis is difficult.

Industry Recognition

AIETEC officials point out that the general problem of human factors is increasing increasing industry recognition. Lockheed and QPR as its expert since F-104 Starfighter. Compare this with QPR at its Miraflores, Cal., plant where it is building C-130 cargo planes and it has a human factors staff working at its Miraflores Division.

Boeing has just established a new human factors group. Among its first tasks is the development of a criteria of man-made "error" for future aircraft which will be at speeds exceeding 3,000 mph. The system will probably eliminate the possibility of air flight collisions, according to Boeing and will have many other advantages.

As the company points out, if two planes approach each other on a collision course at such speeds, the pilots would only have 10 seconds to alter course if this, spotted each other 10 miles away. At such a range, even radar would appear in such speeds in the sky.

So Boeing has found it necessary to take a new look at airplane design from an operational viewpoint and the human factors group has been created this job.

Other manufacturers among QPR are North American, Douglas, Convair, Fort Worth, Northrop, and Hughes Aircraft Co.



Sleds Used in Tests at Edwards

Two types of sleds are used at Edwards AFB, Calif. Powered nose sleds (top), powered by a 50,000 lb. thrust Rocketdyne liquid propellant engine, test water brinks at end of 5,000 ft. run. McDonnell sled (below) built by Hachco-Bond Corp. tests F-101A canopy, ejection seat. It is built of aluminum alloy in conventional aircraft techniques, is powered by 14 solid propellant sleds of 21,000 lb. thrust each.



EAGLEPLANE supersonic XQ-4 drone, mounted on wing of a B-58, is undergoing flight tests. It is launched, recoverable by parachute.

Supersonic Drone Is Evaluated

Los Angeles-Supersonic Rocketplane XQ-4 target drone with a cruise "in excess of 60,000 ft." will be built for USAF under contract for \$1,642,000.

In previous weapons evaluation of air defense systems, Malaria is a subsidiary of Northrop Aircraft and appearance of the XQ-4 indicates that it has some Stock design influence in it.

High aspect ratio, sharply swept wings of Northrop S-600 Stock are replaced by short, deeply tapered straight wings on the smaller XQ-4 since range is less important in target drone. Straight high aspect ratio dials stabilizer is required on XQ-4 for longitudinal stability and control because of wing change.

Ann of Northrop's Scout turbojet engine along with tail fin and fuselage facing other than being at negative angle as in S-600.

The drone is intended to be launched but can be ground launched. A three stage parachute is used to decelerate it to stop during recovery. XQ-4 can carry tracking and aiming aids and photographic and/or television vision sensor equipment. Radar guidance is used.

Example: dimensions are:

- Length 35 ft.
 - Span 32 ft.
 - Fueling diameter 2 ft.
- First flight tests at Holloman AFB, N. M., have been successful.



DOEHL has design mounted nose, engine, unlike Stock, parabolic facing (below).



Vought is shaping inertial guidance for a new role in sea-going missiles

Long-range guidance . . . completely self-contained
Fine terminal accuracy . . .

Ability to handle quick changes in launching position and variations in course . . .

These are capabilities Vought engineers are designing into an inertial guidance system for missiles. In many other ways, too, this project is one of a kind.

- It's a sea and air venture, involving the compatibility of guidance systems with winds, and of missiles with ships.
- It will reach its climax on a vast proving ground, ranging from the North Atlantic to the South Pacific.
- It will require the systemization of components

much more intricate than present-day systems require.

• It will necessitate the most advanced development facilities, including flight test aircraft (as-mounted for inertial guidance), and the Navy's extensive equipment for navigation research.

And perhaps most important to the engineer—development, design, systems work, flight and sea tests will all be directed by Vought engineers.

These men introduced *Berkut I*, the Navy's only surface-to-surface missile with a 600-mission record. They developed the sophisticated *Berkut II*, a new which a new generation of submarines is being designed.

Watch for progress reports on their newest program. Better yet, if you're an engineer—join them!



Vought's removable flight test vehicle, the two *Berkut II*, have preserved invaluable guidance data while registering savings to the government and the taxpayer of almost \$180,000,000.



Vought's *Berkut II*—newest sea-going missile—will serve as primary weapon in Navy's nuclear fleet.



4 IMMEDIATE OPENINGS FOR ENGINEERS

Inertial Guidance Systems Engineer. For key role in developing guidance system flight test technique. B.S. in Electrical Engineering or Physics, experience with gyro and accelerometer or digital computers.

Guidance Design Engineer. To be responsible for design and development of electronic components and systems for precision aircraft guidance. Requires engineering degree plus 2 or more years related experience.

Electronic Support Equipment Engineer. To analyze a complex multi-electronic systems and to design the necessary launching testing equipment for maintaining the system. Requires degree in Physics or E.E. plus 2 or more years experience.

Electrical Engineer. For assignment in design analysis and test of electrical power generating systems for present and future aircraft. Requires degree in E.E. and 2 or more years experience.



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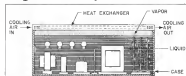
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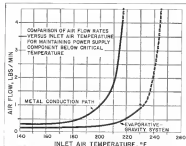
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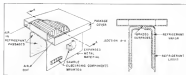
By Philip J. Klein



TEMPERATURE vapor cooling technique, developed by Raytheon, maintains avionics components in liquid state in chassis with heat exchanger mounted on top. Compressed heat exchanger liquid which rises to heat exchanger where it gives up heat, condenses, returns



COMPARISON of evaporative-gravity cooling and conventional metal conduction cooling showing air flow versus inlet air temperature to maintain critical component temperature.



AVIONICS design, combines evaporative-gravity cooling and metal conduction techniques for equipment where it is not desirable to immerse components in liquid.

Washington—New approach to cooling avionics equipment, which reduces amount of cooling air required by 50% or more and permits more compact component configurations, offered non-indecent interest here at the recent Military Electronics Convention.

Called Evaporative-Gravity Cooling or "ev-grav," for short, the technique was developed by Raytheon and reported will be applied in the installation of a new airborne radar under development. The technique was reported by Dr. Melvin Mark, consulting engineer, in a paper considered by Mark, Stephen and Carter Collins, both of Raytheon's Weyland (Mass.) Laboratory.

The technique employs simple evaporation and condensation of a liquid to transfer excess component heat to a heat exchanger (cooled by air) instead of conventional metal conduction paths between components and heat exchangers.

The mark, Dr. Mark said, is a far more efficient transfer of avionics component heat to the exchanger (and cooling air) and near equivalent of the temperature of all components, eliminating hot-spot problems.

Gravity Assist

In a typical configuration, the avionics equipment is mounted in a sealed case with the heat exchanger mounted on top. The case is evacuated, then filled with a liquid to a level which fully immerses all of the internal components, leaving at least a small voided area to receive the top of the liquid and the heat exchanger.

The heat transfer fluid employed is a frozen refrigerant or fluorocarbon but it does not perform as the familiar refrigeration cycle. Instead, heat from the avionics components immersed in the liquid causes it to vaporize, carrying off the heat. The vapor rises under its own pressure, comes into contact with the heat exchanger, gives up its heat to the exchanger and condenses into liquid again.

Gravity returns the condensed liquid to the pool below and the cycle is repeated.

This provides a very efficient liquid-to-liquid heat transfer because the vapor is uniformly distributed over the full area of the exchanger, Dr. Mark points out.

To compare the cooling efficiency of the new system with metal conduction paths commonly used, Raytheon built

two power supplies. One used the ev-grav technique, the other metal conduction. The power supplies included a transformer with maximum allowable original temperature of 180°C, a diode and with maximum service temperature of 140°C. Silicon diodes rated for 155°C (a rise to 180°C and a capacitor for 125°C. The capacitor was the critical component in metal conduction design.

The conventional design had its components mounted directly onto the heat exchanger (cold plate) in the base using metal clips and leads. The ev-grav model was filled with F-114 refrigerant and its heat exchanger was located on top.

Cooling Comparison

Tests revealed that at low cooling air inlet temperatures, around 140°F to 160°F, the conventional design required more air flow cooling air flow rate as the ev-grav unit for equivalent component temperatures. At higher inlet air temperatures, around 200°F, the ev-grav system had a 4:1 advantage in inlet air flow rate.

When inlet air temperature exceeded 224°F, as amount of cooling air could keep the components below their peak temperature levels with conventional metal conduction whereas the ev-grav system could do so with inlet air temperatures up to 255°F, Dr. Mark reported.

The ev-grav cooling tests to measure the temperature differential between individual components as well as between a component's internal and

surface temperatures. For example, the temperature differential between the transformer primary coil and its surface was only 12°F with ev-grav cooling, compared to a 34°F differential with conventional design.

Weight Comparison

The biggest ev-grav advantage was achieved despite the fact that the unit was constructed in a smaller container (35% less volume) than the conventional counterpart, giving lighter heat dissipation.

The high dielectric strength of the refrigerant, Dr. Mark said, makes possible almost component spacing.

A comparison of the total weights of the two power supply units shows that the conventional design, at 5.45 lb., was about a third lighter than the ev-grav unit at 7.73 lb. The heavier ev-grav, weight stems from the refrigerant and the need for reinforced container walls.

However, the comparison of dead weight does not take into account the weight of equipment which must be added to an ev-grav to supply cooling air.

Approximately 117 lb. of extra air craft weight is added for even pound-for-pound air cooling as supplied at 100°F, Dr. Mark says. When this factor is multiplied by the air flow rate required and this is added to the device's dead weight, the result is what Dr. Mark calls total equivalent weight or TEW, and then he believes should be the basis for comparison.

For an inlet temperature of 155°F,

8185 lb.-min will be required by the engine cooled power supply, compared to 946 lb.-min for the conventional unit, to maintain the critical (topmost) temperature below 125°C. This works out to give the conventional unit a TEW of 11.5 lb., compared to only 10.5 lb. for the ev-grav design, or a 15% weight saving for the latter.

At higher inlet air temperatures, the ev-grav weight advantage goes up. For example, if cooling air inlet temperature is 200°F, the TEW of the conventional design is 28.5 lb., compared to only 17.5 lb. for the ev-grav design, Dr. Mark said.

Technique Limitations

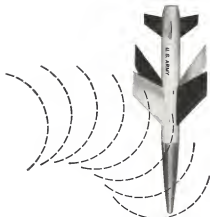
The ev-grav system of cooling adds little complexity because it does not require a pump to circulate the liquid-vapor, relying upon self-generated vapor pressure and gravity. However, the technique does pose certain design or operation problems.

- Liquid must be compatible with materials used in components. Suitable fluorine or fluorocarbon are available, the authors indicated.
- Components must be hermetically sealed or protected by presence of the liquid.
- Equipment can not operate inverted for extended periods of time or at tilt angles sufficient to disrupt the flow of vapor to the heat exchanger and return of the condensate. However, the liquids used have sufficient thermal inertia to absorb component heat for short periods of inverted flight or high tilt without generating dangerously high pressures.



Early Warning Blimp Flies

First flight picture of Goodyear early warning ZPG-1W blimp shows housing for plate on top of bag which supports inflating type airframe (AR June 10, p. 18). Avionic suite retains air flow. Double deck on stage underneath carries flight deck, radar scope, engine, engine control and crew quarters. Blimp's advantages lie in warning missions over low fuel consumption and accurate position



NEW WEAPON, NEW CONCEPT

An important new weapon for a new U.S. Army concept is now being delivered in quantity by Martin-Orlando. This is LACROSSE, a field artillery guided missile, developed to implement the combat concept of the Pentomic Army...a "lighting" Army consisting of self-sufficient highly mobile battle groups. LACROSSE will provide these battle groups with the shockpower of extraordinary speed, mobility and accuracy in heavy armament support of their operations. LACROSSE is the first generation of an entirely new kind of general purpose weapon. All of its components, consisting of the missile mounted on a standard Army truck and a guidance system, can be airlifted to advance areas. The missile is fired in the general direction of the target—without target data at the launching site. Its pinpoint accuracy is controlled by a forward observer. The Martin Company, with more than 16 years of design, production and operational experience in guided missiles, today stands as a leader in this important field.

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Combined Omni

VOR panel indicator, Model 4008, provides variable accuracy and for selecting desired course bearing with miles above and reciprocal heading below, vertical deviation indicator needle, and horizon error indicator. Model 2172 has transducer auto circuitry, for operation with any VOR receiver carrying VOR head, built into indicator. Manufacturers: Leo-Cal Div., Leo, Inc., Santa Monica, Calif.

115 d.c. indicator load.
• 300,000 operations at 60 cps max., 15 cps steady state, 15 v.d.c. (each is might be encountered in starting up an aircraft).

Inventory: Radio's address: 970 McLaughlin Ave., San Jose, Calif.

Expansions, Changes In Avionics Industry

Berkman Instruments, Inc., has formed new Southern Division to handle integrated three-field systems in computer's data processing systems. New division, with headquarters and manufacturing facilities at Anaheim, Calif., and a plant at Redwood, Calif., now includes facilities and engineering facilities part of Berkman's Berkeley and Scientific Instrument divisions. John L. Bishop leads new division.

Other recently announced expansions and changes in the avionics industry include:

- United Control Corp., Seattle, has taken orders for 10 acousto-optic for new plant which it hopes to have in operation by 1968. Company makes acoustic control systems.
- Northern Electronics, Inc., is new name of the former North American Instruments, Inc., Alhambra, Calif., manufacturer of instrumentation and data processing equipment.
- Dayton, Inc., has established new Columbus subsidiary, Dayton, Ltd. and says it will build manufacturing facility in the Viscon area.
- Raytheon Manufacturing Co. will add another 20,000 sq. ft. of space to its present 108,000 sq. ft. Maynard Mass.



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Ti-built guidance and control systems fit into extremely cramped quarters aboard many of the latest U.S. missile types. Using advanced manufacturing methods and rugged TI microelectronics, Texas Instruments is playing an important role in the evolution of missiles that fly farther and faster...with greater payload and reliability.

Whatever the assignment, Texas Instruments is delivering precision systems that save weight, space and power...including audio, inert, radio, radar, infrared, and other systems for detection, navigation, fire control, and communications as well as missile control. With a half million sq. ft. of plant facilities in an excellent disposal area and with over a quarter-century experience, TI is prepared to build virtually any electronic or electro-mechanical system to the most exact military specifications...within a reasonable lead time.

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ICBM Tracker

TL3436 telemetry antenna for extensive tracking of modified ICBMs is installed at Melbourne, Fla. Part of five being built for USAF by Radioelek, Inc., antenna is 63 ft in diameter and weighs lighter than a two-story building. Secondary use may be for tracking of earth satellites. Other installations are to be at Cape Canaveral, Azores, Azores Island and Povoado de Namão.

Laboratory, part of its Component Equipment Division.

• **Bendix Aviation Corp.** has licensed Thermo Electronic Industries of Boston to re-evaluate its radio gear connections for aircraft main use.

• **Multi-Component Manufacturing, Inc.**, Menlo Park, Calif., will manufacture, market and service electronic test instruments and electronic data recording systems developed by PacificM Electric & Airplane Corporation's Electronics Division under recently signed agreement.

• **Avionics Division of AEC Industries, Inc.**, has consolidated its facilities with occupancy of third building in Tucson, (N. J.) Industrial Park off Route 17. All of firm's activities are now contained here except for group at its original 18,000 sq. ft. site about one mile east on Route 17.

• **Consolidated Electronics Corporation's** Spectra Division, Morrisville, Calif., has purchased optical production and testing equipment of Yeda Mfg. Co., El Monte, Calif.

• **Esbeck Radio Engineering, Inc.**, has opened new 25,000 sq. ft. facility at Clovis, Minn., consolidating its activities in the new location. Company

produces drone guidance and ground support equipment.

• **Techniques, Inc.**, has expanded facilities of its Pacific Circuit Division, Rockland, N. J., for sample and short-order runs of etched circuits.



• **Extending Radio Range-Velco** engineers technicians which permit a 50-100% increase in range of radio transmitters used in recent tested Radio Video Interference Study, by Ray W. Hamrick, Cornell Aeronautical Laboratory, Buffalo, N. Y.

• **Troubleshooting, Tubes Down-Scanned** radio tubes sold under one million transactions during last five months of this year, more than twice the 5.6 million sold in same period last year, according to figures released by Radio Electronics-Televisions Manufacturers Assoc. Recording tube sales for same period were down slightly from last year, 1975 at 188.6 million. Total transistor dollar volume for first five months was \$251 million versus \$19

million in 1974. Accounting data for same for comparable period was \$199.4 million (1977) vs \$252.2 million (1978).

• **Typo For Defenses-New Air Force** predicted, for its study design provides data for estimating the effects of vacuum tube operating temperatures, heater voltages and other variables on tube life and reliability. The 51 page report, classified FR 12179, Electron Tube Operation as Influenced by Temperature and Voltage, by T. H. Briggs of the Wright Air Development Center is available for \$3.50 from Office of Technical Services, Dept. of Commerce, Washington 25, D. C.

• **AC To Speak Replaces-AG Spoke** Plug division of General Motors is developing inertial guidance system for use in the Chevrolet Vega's Regulus II surface-to-surface missile. AC also is producing inertial systems for the Marlin missile and has just received a \$58 million contract for inertial guidance equipment for the Texas Instruments range ballistic missile.

• **Push To Road-Radiobly** new technique for attaching tape leads to test sockets and sockets which require only moderate heat and pressure has been developed by Bell Telephone Laboratories.

When wire is pressed against silicon as germanium crystal with force of ten thousand pounds per square inch, using a heated wedge that is held in hand, bonded to crystal as matter of seconds. RIT, reports. Another approach uses lead with ballpoint tip, applied under pressure using a capillary tube (See photo). New "thermo-compression" process, whose basic operating mechanism is not fully understood, per-



Radio-Radar Absorber

New absorbing material, called Rumsok CARB 500 for use in defense areas, reportedly absorbs for less 25% of incident energy at all frequencies above 10 cm. Manufacturer: Emerson & Cuming, Inc., Canton, Mass.

under a number of advantages, according to RIT.

• **Stronger bond—stronger than the lead itself.**

• **Radiably adapted to mass production.**

• **Requires no chemical flux which can contaminate crystal.**

• **Probably some economic lead positioning, an important factor in improving transistor high frequency response.**

• **Flight Duration For Jet-Fire** range equipment has been ordered Collins RTO-115 Integrated Flight Systems (IFS) for use in three new jets and turboprops. These include: Boeing for its Boeing 707 and Lockheed Martin, Continental for its Vulcan Viscount, Eastern for its Douglas DC-10 and Electric, Western for its Electra and Trans-Canada for its DC-10 and Vickers Viscount.

• **Biggest One Test-Universal Transducer Products Corp.**, New York City, wins its General Services Administration award for \$8,800 to \$2,500 transducer radiological sensor meters and diagnostic changes is the largest contract for transducer products ever awarded by the government. Amount of the contract is \$853,770.

• **CAA Buys High-Speed Teletype-Civil Aviation Administration** has ordered high-speed teletypewriters capable of operating at 100 words-per-minute for installation in six three-remote weather networks. The \$37 million order was placed with Teletype Corporation. New equipment will be installed at all CAA, all traffic control facilities, Weather Bureau offices and meteorological weather offices.

• **West Coast Shave-Electronics** industry in Los Angeles area now makes up 11.2% of total number of U.S. electronics firms in 1975, produced 15% of the industry's output according to in-

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"An infinite capacity for taking pains"

The above phrase is usually given as a definition of genius. We borrow it as a job description.

The trouble is which our Quality Control people go to ensure the reliability of our complex products, are only painstaking, and an applied equally to components we make ourselves and those we purchase from outside suppliers.

For example, consider vacuum tubes, the heart of hundreds of products in our Electronic Division. No one checks whether here (even if that's all our customers specify)—but a whole series of critical tests, including such precise measurements as these:

Inspection of tube characteristics in rigid thermoplastic carbonization—performed on special equipment

which can do in a half hour what would take days on conventional testing devices.

Inspection by X-ray, looking for deeply hidden potential faults which could cause malfunction at any time after first use.

Inspection by microwave, seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. All components must pass similarly rigid tests, to assure operating performance, regardless of reliability in the completed equipment.

You can't put a price on "taking infinite pains." You can place your confidence in a company where this is everyday procedure.



STROMBERG-CARLSON COMPANY

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factory at Rochester, N. Y.—West Coast Plant at San Diego 441 San Antonio, S.D.



Infrared Gem

Sapphire supplies, nearly three inches in diameter, produced by Linde Air Products Co. for infrared applications. Supplies has high IR transmittance and is about 10 percent, can be operated at extremely high temperatures and has good thermal shock properties.

by West Coast Electronic Mass Industries Assn. Survey shows that West Coast electronics companies (in 11 states) contribute 19% of nation's total and last year produced 24% of electronic industry's total output. San Francisco area electronics industry expects to increase 1956 plant capacity by 50% (1.5 million sq ft) and sales by 41% this year, WCEMA survey indicates.

► RCA Transponder To CAA—Civil Aeronautics Administration has ordered 16 of Radio Corporation of America's AVD-60 air traffic control transponders for early 1956 delivery, to be used in CAA optional evolution of ATC beacon system.

NEW AVIONIC PRODUCTS

Components & Devices

► Flightmaster pick-off accelerometer, Series 4202, for automatic control and flight testing, provides dual or single pick-off and/or switch pick-off. Area built as a range of G ranges, and is equipped with automatic output and self-resetting test signal features. Address for more



write a M/S. Manufacturer is Pacific Scientific Co., P. O. Box 21079, Los Angeles, Cal.

► Metal-Glass resistors, Series 850, offer low noise and low resistance values with very low active impedance component, and are capable of operation from -65°C to 150°C. Resistors are hermetically sealed in three sizes in ohmic range from 2 ohms to 4 megohms in accuracy from $\pm 0.5\%$ to $\pm 5\%$. Manufacturer: Davis Co., Lexington, N. J.

► Magnetron frequency detector, Type B-5116, operates from 0 to 10 kc for use with radiofrequency probe rate meter.

ation, electron technicians, direct reading frequency meters and automatic speed controls. Unit produces 1 ma full-scale output linear within 1% of full scale. Change in output voltage from 105 to 115 volts produces about 1% change in indicated frequency. Manufacturer: Aerovac Products Co., Fort Lauderdale, Fla.

► High-temperature servo motor, Type 3-900-62, for 400 cps constant continuous duty for mechanical applications. Unit measures 0.863 in. by 0.75 in. OD, weighs 1.2 oz., operates from -61°C to 121°C and meets MIL-B-5212. Voltage is 46/20 on control

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New QUAKER hose for starting jet engines ... fast!



Synthetic fabric jacket and silicone tube retain temperatures from upstream to downstream end

Made in continuous lengths up to 30', this new Quaker hose stays uniformly compressible as high as +400°F, as low as -80°F.

As the above diagram shows, the hose keeps heat loss—heat transfer energy loss—to a minimum. (Comparable outside temperature of ordinary air or ducting material, such as stainless steel, would be about 400° F.) Both the silicone tube and the synthetic fabric jacket of Quaker's new hose hold the heat!

Other advantages? The hose is light-

weight and fully flexible. And it meets abrasion.

Available in either single or double jacket, the hose comes in 1" to 4" I.D., a 3/4" and 1 1/4" I.D. can be made in 30' continuous lengths, 1 1/2" to 4" I.D. in 50' lengths. The hose takes regular expansion and shrinks back completely.

Want more information? Write to: H. K. Porter Company, Inc., Quaker Rubber Division, Philadelphia 24, Pa., or Quaker Works, Pittsburgh, Cal.

**QUAKER RUBBER DIVISION
H. K. PORTER COMPANY, INC.**

phase and 26 on final phase. Motor has an load speed of 6,500 rpm and stall torque of 0.15 oz-in. *Motor data:*

Edco Motor Mfg. Co., Avenue Dixie 1000, 1 Main St. Racine, Wis.

• Right-angle tube shields, with integral sockets for resistor and semiconductor tubes, provide heat dissipation for printed circuit applications. Standard shielded sockets are not to shield



assembly in Max-Elco epoxy resin capable of withstanding operation at 175°C. Right-angle sockets permit use of heat sink or direct cooling. Shield is manufactured by International Electronic Research Corp., 145 W. Maryland Blvd., Berkeley, Calif.

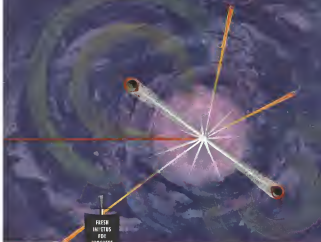
• Flat-top resistors, Type P, are single ended resistors available in seven sizes from 1 ohm x 1/8 to 2 ohm x 1/2 in with ratings from 0.1 to 0.4 watts. Designed for direct mounting on printed circuit panels, resistors are obtainable in values to 1 megohm and



operate at ambient temperatures to 125°C. Tolerances are from 1% to 0.02%. Type P resistors reportedly meet applicable tests of MIL-R-31A, Aresnik 4, and are manufactured by Resistor Products Co., 514 S. 11th St., Harrisburg, Penn.

• Digital coder, constructed entirely on printed circuit boards, operates at 24,000 samples/sec with a bit rate of 104 kb. Ten bit coder will digitize one channel of analog voltage with a frequency response of 15 kc or perform multichannel digitizing in conjunction with a multiplexer. The output is either serial binary or parallel binary as desired.

Radiation, Inc., P. O. Box 37, Melbourn, Fla.



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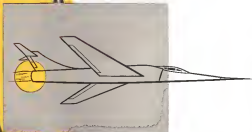
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and be sure to Specify LINEAR "O" Rings for every application.



HOIST SS.10 wire guided missile fired from Alouette is controlled by co-pilot. Head end missile successfully against Egyptian tanks.

Alouette Fires SS.10 Missile



ARMED Alouette approaching in firing run carries three missiles on hoist on each side of the helicopter.



REAR VIEW of mounted missiles shows trim tabs where wire is attached.

RIGHT SIDE boom shows mounting details from front. Improved SS.10 is in production.





FINAL CHECKING of LOX converters at Air Equipment's plant. Each converter is filled with LOX and placed on a scale. After 24 hours an inspector checks weight to assure that the equipment has a within-permissible fault.

Space, Weight Gain Boom Liquid Oxygen

By George L. Christman

Recess, Ohio—Liquid oxygen is rapidly displacing aviation's old standby gaseous oxygen, for a breathing supply as high as 100 gals. It and one of other liquid gases are making cryogenics a necessary science in aviation.

An industry spokesman predicts that all future military aircraft having an oxygen requirement will be liquid oxygen equipped. Possible exceptions may be basic trainers. While the conventional gas currently being built will still be gaseous oxygen systems for the time being, their conversion to liquid oxygen—LOX—is a possibility.

Space, Weight Saving

Principal reason for the switchover to liquid oxygen is that LOX systems take out eight to the space and weight only one-third as much as gaseous oxygen systems of equivalent capacity.

Weight savings of LOX over gaseous oxygen systems are:

- Typical bombers—314 lb. Installed system weight for LOX is 120 lb., for gaseous system, 414 lb.

- Typical fighters—18 lb. Respective in-flight system weights are 10 lb. for LOX and 28 lb. for a gaseous system.

Moreover, substantial installation and maintenance economies, and time saving derives from the fact that a 25 liter

liquid oxygen converter system can contain only seven standard pistol-size cartridges compared to over 200 cartridges for a comparable gaseous oxygen system.

Volume-to-weight ratio of LOX to gaseous oxygen is approximately 3:60.

Liquid oxygen, along with other very cold liquid gases, such as liquid nitrogen and liquid helium, is also being placed into new aircraft in smaller as well as in planes.

All three liquid gases can be used in waste reduction, power systems to operate various controls, for pressurizing various portions of the weapons or jet or carburetor for engines, heat sinks or compressors. Nitrogen, being inert, can also be used to purge or protect fuel systems in certain missiles or planes.

The rapidly expanding use of these extremely cold gases, LOX at -300° and liquid nitrogen at -320° and liquid helium at -450° about reaching absolute zero or -273° C., is giving rise to expansion of aerospace—hereby few little used in aviation.

Cryogenics is the study of very low temperature elements; their properties, effects and how to handle them. Liquid helium, for instance, is best kept in a container immersed in liquid nitrogen to help keep it chilled.

LOX has already gained a firm foot

hold in military jets, trainers, fighters and bombers.

This partial list of LOX-equipped Air Force and Navy aircraft ranges from observation models to some that are not yet flying, indicates the wide spread use of liquid oxygen.

- Fighters: F and RF 34E, F-105C, D and E, F-105A and B, F and TF-332A, F-104A and B, F-105A and B, F-105A of the Combat team, Navy's F-5 and 4, F-101F, F-101, F-4D and F-4D.

- Bombers: B-47, B-52, B-57, B-58, B-56.

TF-1 trainer is also LOX equipped.

Pressure Suits

A relatively new use of the gaseous oxygen produced by LOX converters is to inflate the pressure suits now being worn by an increasing number of military pilots. Reason is that since the pilot is already connected to his oxygen system for breathing at high altitudes, it is a relatively simple matter to use the same oxygen source to supply pressure to his suit in case of bail out instead of having to bring in some other source which is not already connected to the pilot.

While the USAF and Navy both started using LOX in about the same time several years ago, the Air Force incorporated its liquid oxygen program

more rapidly than did the Navy, which was faced with the difficult problem of providing LOX ground supply equipment aboard aircraft carriers.

Commercial jet airliners being built in this country, the Boeing 707, Douglas DC-8 and Convair 440, currently along with gaseous oxygen systems, may convert to LOX within five years, or possibly much sooner, to take advantage of the system's weight and space saving.

On the Boeing 707, for example, conversion from gaseous oxygen to LOX will involve a weight saving of 187 lb., yet the oxygen supply is increased by 2,150 liters, or about 19%.

Big boost to airline manufacturers and airlines alike is the fact that gaseous and liquid oxygen systems are compatible. Switching from one to another involves little more than removing the 3,300 psi gaseous oxygen bottles and their pressure reducing and regulating valves with much lighter and simpler LOX converters, which will operate at a pressure of approximately 65-100 psi.

Sufficient length of line, or line exchanger, will be provided between converter and pressure regulator to warm the very cold gas to near ambient temperature.

Transport Use

Oxygen systems on the Air Force commercial jets will be used for two purposes: therapeutic reasons and to cope with such emergencies as explosive de-compression. Several factors dictate that this status remain gaseous for the time being. Among them are:

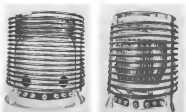
- General servicing equipment for LOX is now limited at commercial airports, both here and abroad.

- Regular topping off to replace oxygen which inevitably boils off a LOX container must be accomplished approximately every 48 hours and large jet (20-25 liter) containers have an allowable head loss of 8% of their volume by weight in 24 hours. In the case of a 25 liter unit, a total of six pounds of oxygen is lost every 24 hours or 10 lb. per 48 hours. Rapid handling techniques required when using LOX would mean a considerable increase for all personnel handling this material.

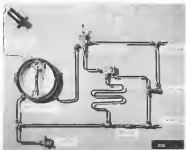
- Airline manufacturers personnel are thoroughly trained on and familiar with servicing and maintaining gaseous oxygen systems.

- Airframe manufacturers, who have long and successful experience in designing and installing gaseous oxygen systems, are not anxious to go to the still relatively new LOX system in their new jets whose auxiliary systems they are striving to keep as simple and fool-resistant as possible.

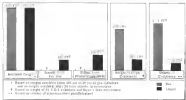
But, as more experience is gained



COMPARISON of 28 liter LOX converters. Aero unit at left. Breda unit on the right. Note difference in shape and that Breda uses steel cables to reinforce its unit.



MODEL of a typical Aero LOX system equipment mount. LOX vessel is at left. Breda compressor (below) of liquid to gaseous oxygen system for a typical bomber installation.



to interfere with or direct the search. When the distress problem is solved, Aon's own development personnel take over the search for solutions.

Example of search forced out projects:

- **Dynamic properties of liquefied gases.** Oxygen, in particular, which was handled to the University of Michigan. The area had been searched developed the first comprehensive information available on the behavior of these oxygen under pressure, at high altitude and in motion, according to Aon. Using data resulting from this program, Aon was able to alter the design of its LOX container substantially to increase its efficiency. The study contained in order to supply Aon with further data for use on cryogenic products.

- **Welding methods for vacuum vessels.** which was assigned to Battelle Memorial Institute. Manufacture of LOX containers, for example, brought up special new production welding problems because of the extreme cold of the liquid oxygen at contact. Also, because of their perfect vessels had to be manufactured between steel and other systems, special welding techniques, such as a positionless beam, had to be developed to avoid cracks, porosity, and stress corrosion. The materials, after thorough study, recommended the proper welding methods and types of equipment needed. (Electric welding equipment is used.) Aon followed the publisher's suggestions and turned go welders in the new technique. Battelle advised. As a result, the manufacturer, on a production basis, has been able to convert to other specifications.

- **Vibration studies.** now given to the University of Iowa.

The university was able to solve a serious problem of stopping people with vibration.

An technician have developed several significant refinements in the art of building LOX containers which are, essentially, highly efficient thermal bottles. They are designed to store, pump, and other accessories to allow liquid oxygen to vaporize into gaseous oxygen and release it under the most efficient means and controlled process to a plane's oxygen system.

A process which An technicians are unique to their containers is the incorporation of a large number of gaps between the containers inner and outer plating to produce a vacuum that is as clean as possible.

Berlin Press

An engineers say that the human, in the form of a line, in a field, when as plain between the spheres, at a temperature of 2,800° F. is in isolation only.

This activates the human which first starts the process of getting or absorbing an impression which might be present in the vacuum. Impurities absorbed include atoms, molecules, carbon dioxide and water. An oxygen container (first human is far superior to conventional devices) can only be used for that purpose because the human absorbs the impurities present in the vacuum, which absorb impurities at normal temperatures. Although, again, when heated. Although human has this property,

its relative temperature is much higher than the minimum operating temperature of the container.

Conductivity advantages of the human system, which operates for the life of the container, are:

- **Lengthening the life of the container.** Initially, containers were warranted for only 30 days. When human gotten were installed over months ago, it became apparent that the warranty time could be increased. It was first extended to 90 days, and now it appears that a one year warranty is perfectly feasible. An officials believe that further non-such extensions are in the offing.

- **Recover up to 75% of container cost.** The human, through various means—within certain limits.

Other container advantages would be An officials:

- **Special high temperature outgassing (leakproof) technique** which drops the permeability of the container to 101 percent of pressure in terms of molecules of mercury. Deficiency of the outgassing procedure is indicated by the fact that a fingerprint on the surface of the vacuum chamber can double the outgassing time, therefore all workpieces are removed.

- **Special pinhole test** is used to seal the vacuum chamber continuously to prevent any air from entering.

- **Special inspection system** is used to ensure that human system which the outer chamber, scratch, wet, keep the heat transfer from LOX container to outer shell to a minimum.

Special personnel are taken to inspect with X-ray all of the entry into container stainless steel stack lead to

Oxygen for Commercial Jets

Exhaust quantity of oxygen for commercial jets is checked by lack of governmental regulation on the matter, by debate on legal vs. private oxygen use, and by lack of standardization among the airlines in its utilization system or economy at all.

Some aerospace officials feel that oxygen is unnecessary because of the concentrated integrity of fuselage and windows of the jets which are built with the same "in" and out of the jets philosophy which decides wing structure. Most U.S. airlines feel that they should provide the added measure of oxygen, at least at the outset.

The British have made no provision for passenger oxygen on Concorde except for those that had been ordered by Capital Airlines. U.S. pilots are opposed to the possibility that they might be required to wear an oxygen mask at all times during flight in Concorde pilots appear to be.

A union pilot of one airline, leaving pillows told Aviation Week. If such a provision is put on the books it will be enforceable unless a FAA directive order in the cockpit of every jet flying. "The meaning of a cabin window leaves out, the pilots will have them to put on their masks—which might be long around their necks—and initiate emergency descent procedures. If a cockpit window blows, as he said, "I don't see that you're not in anyplace. Even if the oxygen is stopped in and doesn't blow out of the cockpit window, he will be left on the head by all the cockpit passengers which will be reached out by the violent blast caused by the large pressure differential between the 5,000 ft. cockpit altitude and the 40,000 ft. outside altitude. . . . but the chances of that happening are so remote as being a way back at."

Pilots who have flown the Boeing 707 over the 15,000 ft. m. emergency area of descent possible in a single safety feature to enable a descent of a low altitude quickly enough that flight of pilots flying consciousness because of lack of oxygen is remote. Additional safety feature is that the 707's cabin windows are so small it will take several seconds—possibly up to half a minute—before the large volume of air within the big cabin is swept through such a relatively small opening to equalize with outside pressure.

Boeing has an agreed plan to use liquid oxygen as the 707, but has made feasibility studies on the subject. Customer preference indicates no present plans to use LOX on 707's.

If a cabin window on the Boeing 707 does blow out over 15,000 ft. an automatic, aerosol-operated trigger assembly, made by North American Corporation, releases oxygen pressure throughout the cabin oxygen system. Pressure of the oxygen almost instantaneously releases masks through bags down located directly above each passenger seat. Extra masks will be provided for children. The masks are smooth shaped of sponge, which is fit comfortably and snug over the passenger's face. Being perfectly streamlined, they are not expected to be put on and in unadorned passengers should be able to produce one on his face in a matter of seconds. Masks can also be manually released from the cockpit.

Whether passengers will have time to use their oxygen masks before they become unconscious because of lack of oxygen is debatable and depends on many factors. Under these speed of mask application, rate of loss of cabin pressure and which pilots are able to initiate emergency descent procedures, and the present's own physical condition.

Whether airlines will follow the industry's example of switch over to LOX is debatable, according to an airline, contacted by Aviation Week. That airlines and that it will definitely not go in LOX. Reason is the added cost and complexity of having and maintaining special ground LOX servicing equipment, the inherent danger in handling LOX, and the labor required by the necessity of continuously looking up LOX containers in order to see for holded off oxygen overcomes the weight advantage of instant liquid oxygen systems over the present oxygen systems. Other airlines are taking a lot of time and cost to build at all.

Lack of economy among airlines about the use of LOX is indicated by these stated reasons in Aviation Week survey of air carriers. As official of one international airline said that it could never use LOX. The cost of operating specialized ground equipment at some bases and the cost of maintaining and topping off LOX at some of its regular stations coupled with the danger of handling liquid oxygen, increases the weight and space savings mask systems would provide for said. Via passenger engineering, of a large domestic carrier and with equal cost that has equipment which contains gas to LOX—probably within 3-4 years—because of the weight and space saving advantages of the system.

LOX Handling Precautions

National Safety Council recently issued these LOX (liquid oxygen) handling precautions which were drawn up by R. E. Carpenter, Safety Engineer, North American Aviation, Inc., Los Angeles division.

LOX, like gasoline vapors, ignites readily when it comes in contact with insoluble materials as oil or fuel. LOX storage area should be away from insoluble materials and sources of ignition and should be clearly marked as a hazardous zone. At North American, the LOX storage tank is completely surrounded by a fence and protected by a locked gate.

Only few personnel have access to the area. They control deliveries and release permits arriving areas. Extra fire equipment has been assigned to the area, and auxiliary flames have been trained from among flight line personnel to work on the tank.

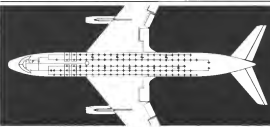
The number of men handling LOX has been limited to those who complete an authorized operator's program. Only one man on each flight line crew is designated as a LOX operator. When it is necessary to fill an aircraft the operator must contact the fireman on duty to check out a portable tank. Before another operator can use the same piece of equipment, the first man must check the tank back in. This means that the operator is used only by inspection personnel.

Precautions to observe before filling an aircraft's LOX system include: place must never be filled with LOX while it is being loaded. Place must not be filled when the electrical system is energized as a low hydraulic power is on. All spilled oil, fuel or kerosene that ends the aircraft must be cleaned away before filling with LOX.

Overheat precautions include: Before filling an aircraft with LOX, be sure that protective gear which are only used by authorized operators. Thus as a load, when going down a full-length track. While the tank is connected with a 500F that it closes, the danger of a one's clothing becoming energized with LOX is not so well understood. Clothing which becomes impregnated with LOX can be ignited some time after the LOX contact by the flame of a torch or lighter.

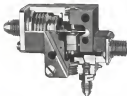
As double resistance against heat failure, the operator must remain at the fire controls during the entire operation so that they can be shut off immediately should the heat be too. Also, the procedure permits excessive outflow which can be handled out. During topping off procedures, the operator must watch the fill level closely to stop flow as soon as the system is full.

Operator must wear his protective garments which allow him to remain at all other personnel on the plane are warned to stay clear during these periods.



SCHEMATIC shows a typical liquid oxygen system layout for one of the upcoming jet airlines proposed by Aon. The diagram indicates one additional mask per line area of seats on right side of cabin. It also indicates oxygen cylinder locations at five positions in cabin structure.

Announcing —



the AeroSWITCH*

A unique control device for monitoring pressures under extraordinarily severe conditions of temperature, vibration, and explosive pressure surges.

The AeroSWITCH monitors fluids between -202 and +8000°F, maintains pressure transients up to 8,000,000 psi/sec without damping, and withstands vibrations up to 2000 gpc at 40 g.

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*Your request for detailed information is invited.
Write: Director of Sales, Aerjet-General Corp.,
Albany, Calif.*

*Pat. applied for. Switch shown here is not a copy.

synthesize the converter shells to assure area permeability, lack of voids and to detect any other imperfections which might be present.

All coils used in the liquid phase of the converter are sealed to metal with surfaces lapped to a very high finish.

Low temperature Teflon seals are used in the gaseous phase of the converter.

As an Aero spokesman said, "a converter is either perfect or it's just a piece of scrap."

Economizer Circuit

A converter economizer, not exclusive with Aero, but used on all of its units is an economizer circuit which maximizes the additive oxygen capacity of the LON system by 15-25%. Under extremely favorable circumstances, the cost may almost double the oxygen supply.

Aero pays for a rather expensive test of its converters. One out of each 150 units built is sent to the Denver Research Foundation where it is subjected to vacuum vibration tests, then is fired at with a 90 caliber armor-piercing bullet.

This is done at Aero's expense. So far, over 50 converters have been subjected to this test.

With an eye to the future Aero recently made a comprehensive proposal to General for a LON system for its F80 jetliner. Total weight of the system, including air intake for cockpit crew and 119 seats in the cabin, is 271 lb.

Aero also has developed for Trans World Airway enhanced LON system requirements for the carrier's upcoming Boeing 707s and Convair 580s.

Expansion Program

In the way of expansion, the company's Aircraft Division has already avoided the last phase of a one five-year expansion program. A separate three-acre plant has been enlarged to twice its original size to serve as headquarters. All aircraft operations heretofore conducted in other locations have been transferred to this plant. It is located at the Congress Center to indicate that all Aerjet products whose operation is related to low-temperature hydrogen gas are consolidated there.

Aero recently suffered a setback with a British contract and General British Oxygen-Aero Equipment Ltd., which is Aero's London subsidiary. The British firm had long experience in designing and manufacturing equipment destined to operate in very cold climates. Aero estimates that its affiliation with the British organization cost it some five-year research and development program time by 3-5 years.

The two companies are now differing

the areas in which they shall work to avoid duplication of effort. In the interim, the British firm is engaged in the distribution of Aero's aircraft products in Europe and will soon be equipped to manufacture them. Among other items, the British firm is put taking up to produce LON converters for NATO.

From 1957 to 1958, Aero's gross profits went up from \$5,017,000 to \$5,446,000. During that year, sales climbed from \$1,107,000 to \$1,791,000 and earnings per share moved from \$2.85 to \$2.15.

Employment increased from 1,810 to 1,702.

USAF Awards Contract For Generator Units

Contract amounting to \$4.8 million for supplying generator sets to be used in support of Strategic Air Command B-57 bombers was awarded by the Air Force to Aircraft and Equipment Division of Consolidated Diesel Electric Corp., Stamford, Conn.

Units are self-propelled and consist of engine driven generator sets which produce 45 and 60 kw for testing of the aircraft's electronic systems, including radar, navigation and fire control.

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Counsel for Hughes, CAB Spar Over His Appearance At Hearing

By Glenn Carlson

New York—Howard Hughes' partner at a Civil Aeronautics Board hearing into his possible control of Northeast Airlines through Atlas Corp. was first stilled by his counsel during the first phase that ended here recently. But Hughes is expected to appear for the second phase of the hearing.

At the hearing's outset, Abraham Miller, Director of Air Operations (realist), tried to arrange a time for Hughes to testify. Hughes' counsel contended that testimony of other witnesses would make his appearance unnecessary. It was agreed that, if all points were cleared up by other testimony and exhibits, Hughes might be spared a session in the witness chair.

Questions Remaining

Several questions remained, however, and Hughes will be called to testify at a time and place as yet unspecified. GAB can subpoena Hughes if need be.

Hughes closed its interest in controlling Northeast Airlines through acquisition of Atlas Co stock, two Hughes subsidiaries did not.

The leasing grew out of past pleading by Eastern Air Lines and National Airlines in the New York Florida case which asked the question of possible Hughes control of Northeast in addition to Trans World Airlines. Such a situation, without Board approval, would violate Section 406 of the Civil Aeronautics Act.

Counsel for Hughes defended the procedure as "harshment" of him for an accidental event. Hughes owns 951,616 shares of Atlas common stock, which at the time of the margin was about 11% of the total and made him the largest single stockholder. His shares now represent about 9% of the Atlas total. Atlas holds a majority interest in Northeast Airlines.

Floyd Delfino, president of Adia, owns 117,156 shares of Adia voting stock, or about 1.2%. Delfino, however, claims control of ownership of 1,280,720 shares, or 13.6%, plus additional control through options exercisable which brings the share to more than 16%.

Boris for the RKO Atlas merger was arrived at in 1954-55, according to T. A. Slack, Hughes Tool Co. vice president and attorney for Hughes and a director of TWA. Slack testified that he carried

on negotiations with O'Brien for Hughes, and was not aware of Hughes' "giving me weight" to the Northeast Airlines interests held by Atlas.

Codham Place

Others paid to sell the Hughes side on sweeping preferred instead of common stock. Slack says, and "advised every person in the world he could think of." One reason was possible correspondence with CAB in ownership of common—i.e., *voluntarily* in a com-

Slack was convinced such common stock ownership was no cause for concern, he testified, and furthermore the deal "certainly wasn't a secret from CAR."

Nash Datsch, TWA director, former Hughes Tool Co. official and now an RKO board chairman, testified that Oellers also had discussed the merger with him and had urged him to recommend that Hughes accept the preferred stock. Datsch said he advised Hughes to insist on the common stock, however, citing on a "general theoretical basis" as the belief that it offered more appreciation potential.



Send-Off for Cargo Service

Start of DC-6A cargo service by United Airlines at Boston was paralleled by an unusual incident which the airline gave credit for to the shipmen. Goods included city and naval officials, traffic managers and shippers.

because its specialized possibilities were
greater.

Hughes "objected to me very strongly," Dutschek testified, that he failed him to take any voting interest in Avco.

Stack also said that Hughes had passed up an opportunity to name some one to the board of directors of the newly created company.

Dellana testified at the hearing that Hughes declared repudiation on the Atlas bond.

Others also claim a connection of Hughes' move to selling Ailes stock to the Northeast Airlines' change in the New York-Los Angeles route, reported that Hughes "has committed himself irrevocably to the president of Ailes to permit the latter to sell Hughes stock in Ailes until such time as Hughes may dispose of the stock."

Prayer Assignment

According to Dietrich and Black, however, no mention of such a group payment was made to them by likelihood.

Elaboration of this point undoubtedly will be asked of Hegler when he testifies.

At the outset of the hearing, Moller dismissed a suggestion that the matter be disposed of by sitting up a voting trust for Hughes stock in Atlas, which trustees acceptable to CAB would own the stock for five years. By the end of that hour the stock would be sold to Hughes.

Conover Hughes, Moffat said, had rejected the suggestion and had reported an offer of notice by Hughes because he voted men of stock. Then after, the bureau counsel said, had been accepted by the Bureau of Air Operations.

Hughes' counsel stated that while Hughes had no share in control Northcoast, his investment in Airco totals \$5.9 million and it seemed unreasonable for a business standpoint to require him to sell within a specified time.

Voting Trust

An alternate suggestion that the voting must be established for a 10-year period and that there be no selling provisions was viewed favorably by both owners and will be studied further.

Hughes counsel called the whole matter a rather closed affair from Hughes' point of view and asked that an agreement be worked to protect Hughes against any public reaction."

The hearing before Economic Paul N. Pfleger was observed by James Arnes, chief of CABA's office of compliance. If the Board finds that the Hughes Atlas Holdings violate a provision of Section 406, the Board itself can specify remedial actions such as disclosure.



Redstone Displayed in Grand Central

Ames's Redstone ballistic missile is displayed in New York's Grand Central station. The 60 ft. missile was built just over a decade ago.

Navy Contracts

Following is a list of unclassified contracts for \$19,000 and over as released by Navy Contracting Office:

ANALYTICAL SUPPORT OFFICE TWO
Los Alamos, NM 87545

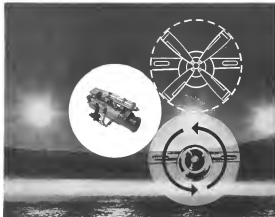
Multi-Inch Research & Development, Inc.
4070 Highway 90, Houston, TX 77057, U.S.A. (e-mail: tom
mccoy@multiresearch.com; tel: 281/450-1044;
fax: 281/450-1044)

Magnum Rock Drilling, Inc. (a/c: MDR), Bayport,
TX 77521 (e-mail: tomccoy@mdr.com; tel: 281/450-1044;
fax: 281/450-1044)

Published and Sold by the Author, 1001 Broadway, New York, N.Y. 10003. Price, \$1.00. Postage, 50c. Total, \$1.50. Order from Book Indications, 1001 Broadway, New York, N.Y. 10003. Tel. 212-474-1144.

Phosphate Use & Malware (p. 1056) Pioneering Partnership: Airtel vs. India. E-mail: airtel@airtel.net (216/505/117) 8400 ext. 2172-087.
 Seraphim Wm. Treadle. Y14226877760
 Shoshnik, Joe. Address: N. 5. 1426. 44484
 (215/2115-103/544293) 1 800 ext. 444 835
 Sperry, Josephine. Pw. Dry. 41. Sperry
 Grant. Grant. Grant. York. N. 5. 1426. 44484
 and publications (415/2115-103/544293/117)
 Grant. York. 2148,241

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Mr. E. A. Goss and to Association of 140 common shares for Lawrence H. Oddy, officer and director, for a holding of \$250. The sum of 400 common shares for Andrew H. Oddy, officer and director, leaving a holding of 111. Holding of 106 Oddy & Oddy shares to Michael G. Philipp, director, the entire holding with holding companies beneficially owning 8888 shares of which Philip's Industries subsidiary is beneficial owner.

Living Air Conditioning, Division of 2000 common shares by Family's Creation. Effective July under building.

Local Law Association of 434 members shows its thanks by May 2 Banquet affair for a building of 2,418 members of 120 members, thanks in connection to Norman Wilson, officer, for a building of 2,418 members.

National Aviation Corp. Reported of 10 common shares by Frederick F. Nieldson officer leaving a building of 111; disposal of 1,000 common shares by Elmer Willis director leaving a building of 1100

Northrop Aircraft Inc. Acquisition of 21% common shares by William C. Smith. Offered by a holding of 1,000. Proposed 1,000 common shares by Edgar Wheeler. Offer having a holding of 1,000.

Northwest Airlines Acquisition of 100
common shares by A. J. Winchell and J.
Glover for a building of 1110

For American World Airways Inc. 20 questions of 100 common shares by Edward D. Matthews director for a holding of 1,950 acquisition of 1,951 common shares by Vernon F. Taylor director for a holding of 2,114.

Financial Records Corp. (Report of all common shares by ERM's General Director listing a holding of 12,094 - total of 30 common shares by 76,844; IL Detail missing shares by 1,000,000,000)

Norfolk Manufacturing Co. Announces 1981 common shares through random selection by D. R. Reid, officer for a holding of 27,138.

[illegible]

building 111st common shares and Under
has a beautiful view over T. Church
East building 901st common shares.

11.415 Award of \$100,000 given by Raymond A. Mott, officer and director, to a holding of 10/2/21

Whitcomb, Blackman & Televisión Corp. proposed a 500-camera shoot of Rod Walter shooting a baseball at 200 mph. Always the champion of the underdog, Mark always put the emphasis on the underdog shoot by choosing F. Ouchal, Jr.

Senior **APPROPRIATE** OR **APPROPRIATE** OF 100 AND
DISPOSED OF 4-100 COMMON SHARES BY ALX
ANDER **MADE** OFFICE AND DIRECTOR FOR A PERI-
OD OF 10

Spirex Steel Corp. disposed of 3,000 common shares to Spirex Limited, a wholly owned subsidiary, for a holding of \$1.00 per share. Spirex Limited is a wholly owned subsidiary of Spirex Steel Corp. and is a public company. The disposal of 3,000 common shares of Spirex Steel Corp. was approved by the Board of Directors of Spirex Steel Corp. on May 1, 1997.

Tricus fuscescens albiceps. (Despond.) - ERII Class A common shaver by G. Ray Clark's ally, Oliver and Harold's crew, leaving a building of 21411.

Called Mr. Linen and Acquisition of 10 common shares by Maffeo C. Janssen (brother of J. & holding of 104) disposed of 10 common shares by Brother E. Drake (brother, holding a holding of 140).

United Aircraft Systems Acquisition is a first common share by Emerson to China Director for a direct holding of 1.1% with the United Aircraft Systems a transaction of which China Director's admission to the Board of Directors is expected to be made.

Western Air Lines Inc., Republic City, Mo., is converting its fleet of 10 Boeing 707s to Boeing 747s, for a saving of \$100,000.

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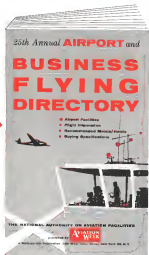
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trouble and expense
at your destination
know what's ahead
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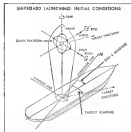
ENGINEERS—SCIENTISTS

GENERAL ELECTRIC SELECTED TO DEVELOP GUIDANCE AND FIRE CONTROL SYSTEMS FOR NEW NAVY MISSILE, POLARIS

New Group Forming as Missile & Ordnance Systems Department of G.E. Adds Navy Project to Nose Cone Development Program.

POLARIS is the most challenging development undertaken by industry for the Navy since the nuclear propulsion program. It is an Intermediate Range Ballistic Missile, whose specifications call for launching capability from both surface vessels and submarines.

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The diagram above presents the primary parameters involved in shipboard launching of a ballistic missile in the simplest form.

For Polaris, MOGSD must not only surmount these initial conditions but solve five control problems more complex than hitherto encountered. Properly executed in missile guidance is an impressive accomplishment under the most favorable conditions. But how do you achieve it with a vehicle launched from a moving platform and aimed at an object approximately 1,600 nautical miles away?

In addition, the Polaris guidance and fire control systems must also operate effectively under the difficult conditions created by submarine launching.

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As prime contractor for IRRM and SCRM Nose Cone Development, MOGSD can draw on a reservoir of top level experience and skill. This G-E department also has a backlog of specialized expertise in the development and manufacture of Naval Fire Control Equipment, such as range-finders, computers and radar antennas.

NEW OPPORTUNITIES FOR ENGINEERS WITH EXPERIENCE IN THE DEVELOPMENT OF GUIDANCE & FIRE CONTROL SYSTEMS

A new group is now being formed to work on Polaris missile sub-systems at MOGSD. It will be located at Pittsburgh, Pa., in the heart of the Institute's missile and systems area. Openings are at all levels for men with experience in:

GUIDANCE & ELECTRO-MECHANICAL COMPONENTS

Design, evaluation of guidance and fire control equipment. Design, development of electro-mechanical components and mechanisms.

Design, development, evaluation of inertial components, systems, gyro, rate, accelerometer, stable platform, platform guidance systems, etc.

Design, development, fabrication of analog computer for guidance and fire control systems.

GUIDANCE & CONTROL SYSTEMS

Mathematical analysis, feasibility study of control systems and techniques.

System, design, evaluation of guidance and fire control systems. Laboratory development, testing, modification of control systems.

ELECTRICAL & ELECTRONIC COMPONENTS

Development of amplifiers and associated circuitry. Development, packing of electronic, magnetic, transducer-type elements and components.

Reliability, production, analysis of electronic elements and components.

Design, development of fire control modules.

System integration design of electrical and electronic components. Development of electronic and solid state devices, test equipment, test instrumentation.

OPPORTUNITIES OPEN ON OTHER MISSILE PROGRAMS

Engage and consult with experience in other areas of Electrical Engineering, Aeronautical Engineering, Aerodynamics, Mechanical Engineering, Physics or Mathematics should inquire about positions on other missile programs at Missile and Ordnance Systems Department.

AN INVITATION

If you would like to contribute to one of the advanced missile development programs at MOGSD, you are invited to send a resume of your education and experience to me for a personal evaluation. All resumes will be carefully reviewed by the managers of our various technical departments. You will be invited to visit our office and conference with me if you are interested in the challenge and when you will be sending documentation will be entirely confidential.

Please send resume to Mr. John West, Room 205 D

MISSILE & ORDNANCE SYSTEMS DEPARTMENT

GENERAL ELECTRIC

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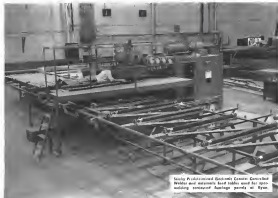
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F-237, F-238, F-239, F-240, F-241, F-242, F-243, F-244, F-245, F-246, F-247, F-248, F-249, F-250, F-251, F-252, F-253, F-254, F-255, F-256, F-257, F-258, F-259, F-260, F-261, F-262, F-263, F-264, F-265, F-266, F-267, F-268, F-269, F-270, F-271, F-272, F-273, F-274, F-275, F-276, F-277, F-278, F-279, F-280, F-281, F-282, F-283, F-284, F-285, F-286, F-287, F-288, F-289, F-290, F-291, F-292, F-293, F-294, F-295, F-296, F-297, F-298, F-299, F-300, F-301, F-302, F-303, F-304, F-305, F-306, F-307, F-308, F-309, F-310, F-311, F-312, F-313, F-314, F-315, F-316, F-317, F-318, F-319, F-320, F-321, F-322, F-323, F-324, F-325, F-326, F-327, F-328, F-329, F-330, F-331, F-332, F-333, F-334, F-335, F-336, F-337, F-338, F-339, F-340, F-341, F-342, F-343, F-344, F-345, F-346, F-347, F-348, F-349, F-350, F-351, F-352, F-353, F-354, F-355, F-356, F-357, F-358, F-359, F-360, F-361, F-362, F-363, F-364, F-365, F-366, F-367, F-368, F-369, F-370, F-371, F-372, F-373, F-374, F-375, F-376, F-377, F-378, F-379, F-380, F-381, F-382, F-383, F-384, F-385, F-386, F-387, F-388, F-389, F-390, F-391, F-392, F-393, F-394, F-395, F-396, F-397, F-398, F-399, F-400, F-401, F-402, F-403, F-404, F-405, F-406, F-407, F-408, F-409, F-410, F-411, F-412, F-413, F-414, F-415, F-416, F-417, F-418, F-419, F-420, F-421, F-422, F-423, F-424, F-425, F-426, F-427, F-428, F-429, F-430, F-431, F-432, F-433, F-434, F-435, F-436, F-437, F-438, F-439, F-440, F-441, F-442, F-443, F-444, F-445, F-446, F-447, F-448, F-449, F-450, F-451, F-452, F-453, F-454, F-455, F-456, F-457, F-458, F-459, F-460, F-461, F-462, F-463, F-464, F-465, F-466, F-467, F-468, F-469, F-470, F-471, F-472, F-473, F-474, F-475, F-476, F-477, F-478, F-479, F-480, F-481, F-482, F-483, F-484, F-485, F-486, F-487, F-488, F-489, F-490, F-491, F-492, F-493, F-494, F-495, F-496, F-497, F-498, F-499, F-500, F-501, F-502, F-503, F-504, F-505, F-506, F-507, F-508, F-509, F-510, F-511, F-512, F-513, F-514, F-515, F-516, F-517, F-518, F-519, F-520, F-521, F-522, 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F-1333, F-1334, F-1335, F-1336, F-1337, F-1338, F-1339, F-1340, F-1341, F-1342, F-1343, F-1344, F-1345, F-1346, F-1347, F-1348, F-1349, F-1350, F-1351, F-1352, F-1353, F-1354, F-1355, F-1356, F-1357, F-1358, F-1359, F-1360, F-1361, F-1362, F-1363, F-1364, F-1365, F-1366, F-1367, F-1368, F-1369, F-1370, F-1371, F-1372, F-1373, F-1374, F-1375, F-1376, F-1377, F-1378, F-1379, F-1380, F-1381, F-1382, F-1383, F-1384, F-1385, F-1386, F-1387, F-1388, F-1389, F-1390, F-1391, F-1392, F-1393, F-1394, F-1395, F-1396, F-1397, F-1398, F-1399, F-1400, F-1401, F-1402, F-1403, F-1404, F-1405, F-1406, F-1407, F-1408, F-1409, F-1410, F-1411, F-1412, F-1413, F-1414, F-1415, F-1416, F-1417, F-1418, F-1419, F-1420, F-1421, F-1422, F-1423, F-1424, F-1425, F-1426, F-1427, F-1428, F-1429, F-1430, F-1431, F-1432, F-1433, F-1434, F-1435, F-1436, F-1437, F-1438, F-1439, F-1440, F-1441, F-1442, F-1443, F-1444, F-1445, F-1446, F-1447, F-1448, F-1449, F-1450, F-1451, F-1452, F-1453, F-1454, F-1455, F-1456, F-1457, 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COMPLEX SPOTWELDING PROGRAM AT RYAN IS SEVERE TEST FOR NEW SCIACY COUNTER CONTROL

Ryan Aeronautical Company, San Diego, California has achieved a significant first in resistance welding—automatic spot welding of large aluminum fuselage panels for the Boeing KC-135 and 707 jets.

Referring to their new Josky County Controlled Welder, Mr. Bob Falkner, Ryan's Sales & Welding Engineer, stated, "This is one new welding development that really does what the advance manufacturers intended."

PRECISE CONTROL

Early in the program, it became obvious that precise demand of all welder functions and absolute production consistency of welding was essential. Introduction of the new Productivity and Economic Control Controlled Welding for Quality System

Here, for the first time, is a miller in which freewheelers are controlled in a freewheel at a cycle of alternating current. Control springs are coiled with resistance. The unwinding accuracy of coarsening is maintained throughout the entire range for the longer run at the highest production rate. Any production control setting is made in accordance with set points.

CONSISTENT. SAME NEEDS

The consistently safe welds produced by the Scuffy Cautious Weld Control are essential to the Ryan program since the skin is a load bearing member. In addition, the size of the assembly—largest every sub constructed in the industry—will not mitigate even the possibility of cracks due to imperfect welds.

The importance of consistently perfect welds is emphasized by the tremendous number of splices in the six footings between the Hoising jet intake structure. Approximately 77,000 spot welds are required to join steel to steel, steel to diaphragm and wingtips, and bulkhead members to members.

TAPE COMMAND OF WELDING OPERATION

Welding operations on the various assemblies can be controlled by a tape command and providing complete part part positioning in all directions. Automatic

interlock between positioner and welder is required. This would provide more automatic operation.

COMPLEX TOOL-UP

Handling and positioning the elements alone also presented a major problem. Ryan solved this by installing large positioning tables with push-button controls to prevent inaccurate loading.

The characteristics and convenient operation of the Slinky Counter Controller Walker combine perfectly with the automatic slakers and economy of the Eyrer postforming table to satisfy the requirements of this complex production machine.

LITERATURE AVAILABLE

Technical bulletins completely describing the new Sudy Protected Electrical Control Weld Control are available. Write on your company letterhead requesting Bulletin 318 and 319.

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AVIATION WEEK, JULY 29, 1972

[illegible]

HOW WHITTAKER GYRO ENFORCES QUALITY CONTROL

Problem: Provide customers with highest quality goods—time after time—through quality control.

Solution: 1) use standardized components which have been tested and proven, 2) the higher the biology level, 3) use

most detailed assembly instructions, and 4) set up 100% inspection tests for any customer requirements.

Result: An overall customer rejection rate of less than 2% for Whiteken Gytex.



Whittaker Gyro

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Timely Leadership

Marion W. Adams
Vice President
Operations & Engineering
Air Transport Association of America
Washington, D. C.

In addition to the development of muscles and air-muscle learned muscle, the most important aspect of walking power which needs development today, is language muscle, and the ability to create a robust force in my place in the world with a relatively short span of time, plus the ability to support that force. We need heavy segments of soldiers or citizens in police

MAJ Gen CLARENCE McNEILL,
USAF (ret.)
San Antonio, Tex.

The Motor Agent entered to the Speed
 - covered red without making one further

Banks was C&D for Segregation, a pilot has the right, or force a claim, to declare an emergency and elect his emergency arbitrator; otherwise, in his judgment, the facts dictate it. Thus Cape Spirit did. The CAV representatives, from the comfort of their offices, would now second guess Cape Spirit's judgment. This, in our opinion, is an inappropriate manner of arbitration as clearly apparent when added to the failure of CAV to provide for the emergency, at that time in crisis.

To add further to the complexity of rooming clubs, the Subcommittee advised the

FOR ITS PROP-JETS AND TURBO-JETS

Electras and Boeing 707s equipped with new Sperry Systems

An amphibious tractor piles a log on a log on the coast. Log movement is still not the

For full details on this new Special Vehicle Indicators System, and all

DIVISION OF SPIRIT AND COMPARISON

Double Hex Self-aligning Nut
Type LHEB3173 • 1/4-28, 5/16-24, 3/8-24



Self-aligning Hex Nut
Type LH2935 • 10-32, 1/4-28, 5/16-24



Self-aligning Self-wrenching Nut
Type LH2956 • 1/4-28, 5/16-24



Self-aligning Anchor Nut
Type LHA3022 • 10-32, 1/4-28



WHERE CAN YOU USE ONE OF THESE NEW SELF-ALIGNING STOP NUTS?

Got a problem in bolting non-parallel surfaces? Still use a costly compromise like hand-selecting tapered shims? Must you resort to time-consuming, unwieldy, multiple spot-facing operations?

For a cost-saving, weight-saving, time-saving solution try the new ESNA self-aligning fasteners. To meet specific application installation problems four different designs are offered: a hex nut to standard dimensions; a double hex, high tensile fastener which develops 180,000 psi in the bolt; a floating anchor nut; and a self-wrenching type. All of these parts automatically correct for angular misalignment up to 8° in any direction from the center line.

- The self-aligning anchor nut serves as a "fixed" fastener for use where the bolt is removable but the fastener remains riveted to the structure.
- The self-aligning hex is designed for applications where a wrenchable nut can be used.
- The 12-point double hex design provides 180,000 psi high strength performance and requires a minimum of wrenching area.
- The self-wrenching design is suggested for locations where tightening with a wrench is impractical. The lug anchors itself against an adjacent surface for easy wrenching.



Each self-aligning fastener consists of a nut body with curved base and mating washer surface which act together on the ball-joint principle. Made of carbon steel for use at temperatures up to 550°F., these fasteners meet Specification AN-N-10 performance requirements and also the torque, tensile, twist-out and push-out requirements of MIL-N-25027 (ASG).

Like to know more about this line of lightweight self-aligning fasteners? Mail the coupon today.

Dept. N38-725, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

- ☐ Standard drawings of four new ESNA self-aligning fasteners.
☐ Here is a drawing of our product. What self-lacking fastener would you suggest?

Name _____ Title _____

Firm _____

Street _____

City _____ Zone _____ State _____